WATER WORKS AND SEWERAGE

July, 1933 — L. H. Enslow, Editor — Vol. LXXX. No. 7

Sewage Treatment Works of Souderton, Pa.

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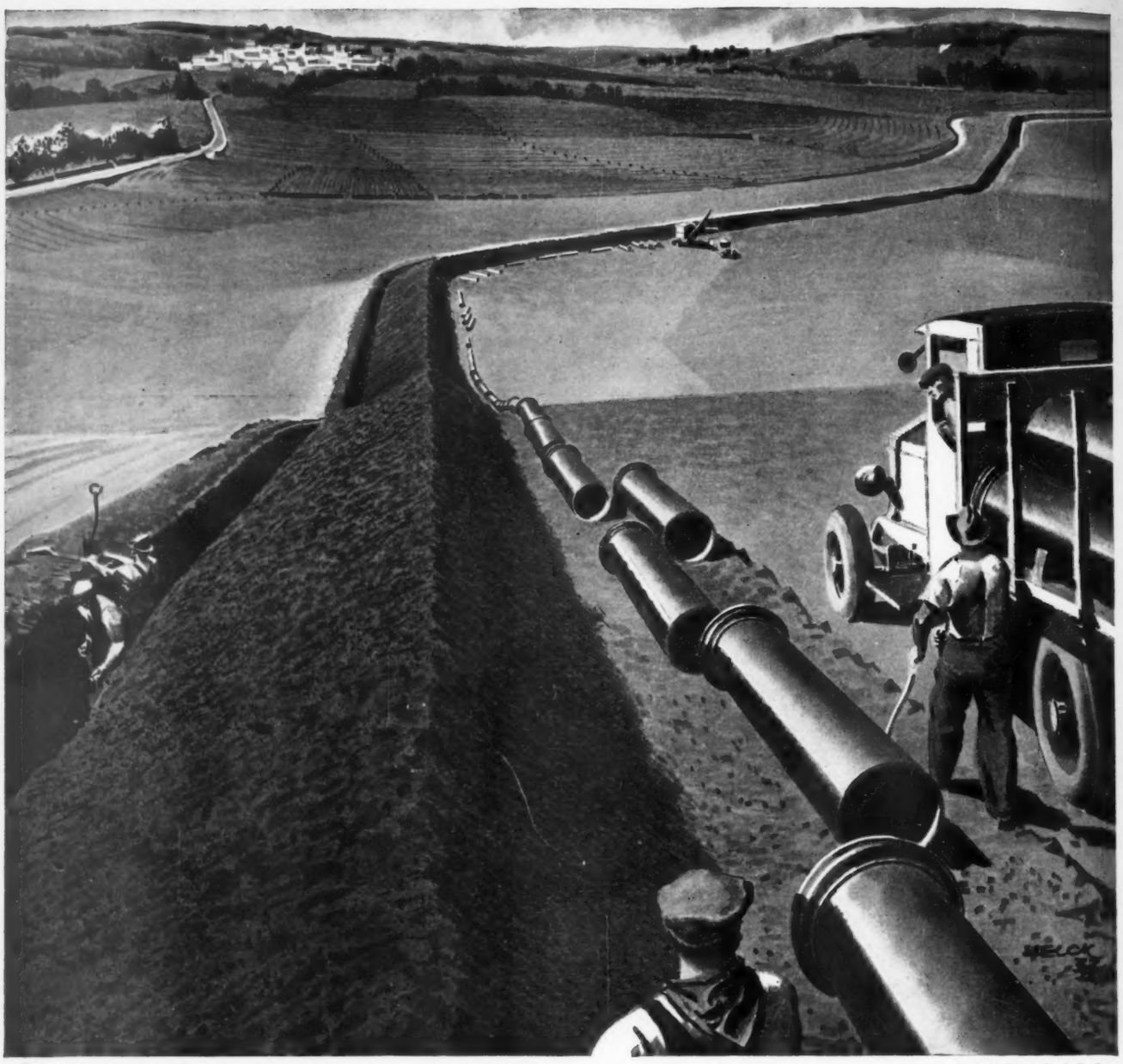
New Water Storage Tank Solves Distribution Problem at Milwaukee
Utilization of By-Products of Sewage Treatment
Report of Convention of American Water Works Association
Costs at Five Sewage Treatment Plants in Illinois
Maintenance, Reading and Billing of Water Meters



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—Excerpts from the Foreword

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WATER WORKS & SEWERAGE

L. H. ENSLOW, Editor

LEADING ARTICLES To Appear in the Next and Subsequent Issues:

Darwin W. Townsend, Principal Assistant Engineer of the Sewerage Commission of Milwaukee, is preparing two articles on "Screenings and Grit Incineration." A description of the new screenings incineration plant at Milwaukee wil be presented in the first. Experiences in operation and operating cost data will be revealed in a second article.

M. L. Crist, Consulting Engineer, Los Angeles, Calif., discusses "The Proper Administration of Municipally Owner Water Utilities" based on experiences gained in dealing with this problem.

Roger W. Esty, Superintendent of Water Works at Danvers, Mass., will recount interesting and unusual "Experiences in Locating Pipe Lines" with the wireless pipe locator.

H. H. Hendon, Sanitary Engineer, Jefferson County, Ala., will describe the new "Sewage Treatment Works of Birmingham, Ala.," in which important well kept cost data are incorporated.

J. S. Dunwoody, Superintendent of Water Department, Erie, Pa., tells of the method followed at Erie in "Handling of Storage Yard Supplies and Equipment" in an article illustrated by specimen record forms and photographs.

Carl Leipold, Superintendent of Filtration, Winnetka, Ill., will continue with a series of articles of interest pertaining to the treatment of water. The next will be—"The Use of Clay as Artificial Turbidity to Lengthen Filter Runs."

Joseph Cordillo, Supervisor of Water Service, Lehigh Valley Railroad, Sayre, Pa., will write on boiler water treatment practices with especial reference to the economy of methods employed on the Lehigh Valley system.

H. G. Menke, Principal Assistant Engineer of the State Department of Health of Alabama, will describe a "Dual Flow Compartment Mixing Chamber" which has been effectively employed at several filtration plants in the South.

Paul W. Frisk, Chemical Engineer, American Enka Corporation, Enka, N. C., will write on their experiences with iron and manganese in filtration practice and the methods evolved in maintaining cleanliness of the filters serving a large textile mill demanding iron and manganese free water.

Dr. Ulick R. Evans, Cambridge University, England, will discuss the "Effect of Chlorides in Corrosion."

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OFFICE PHONE–160

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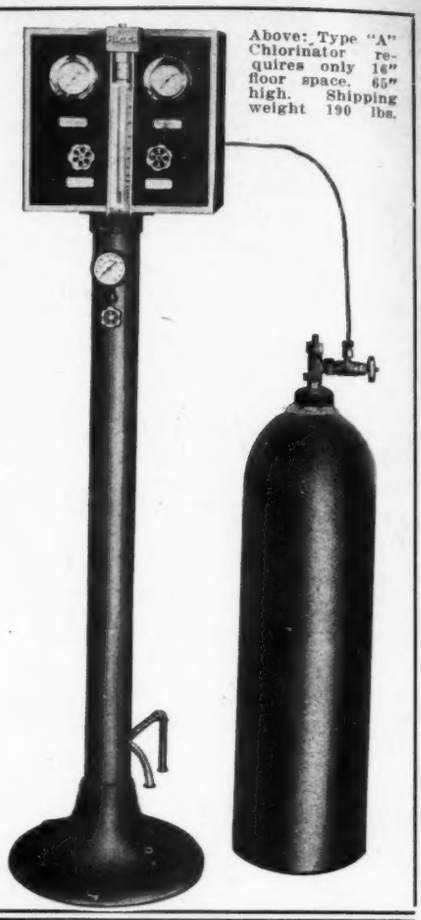

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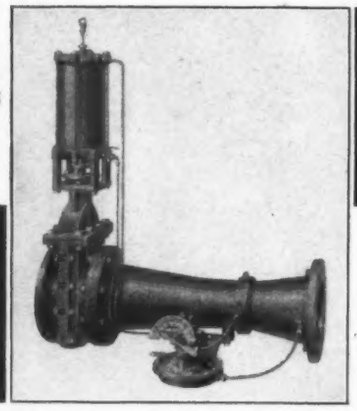

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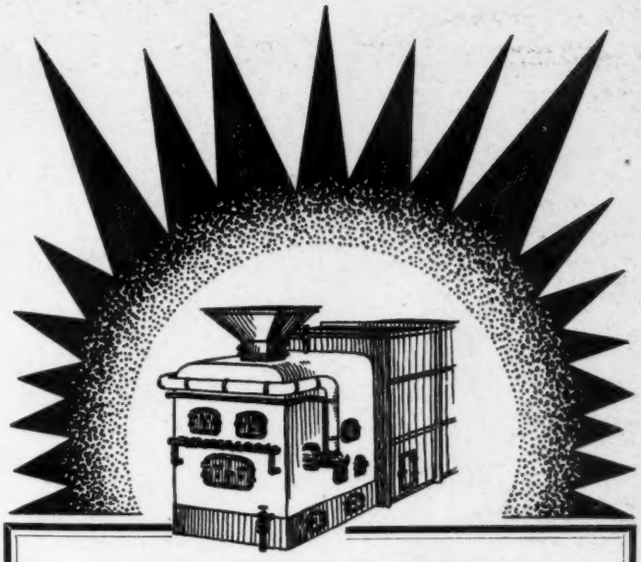

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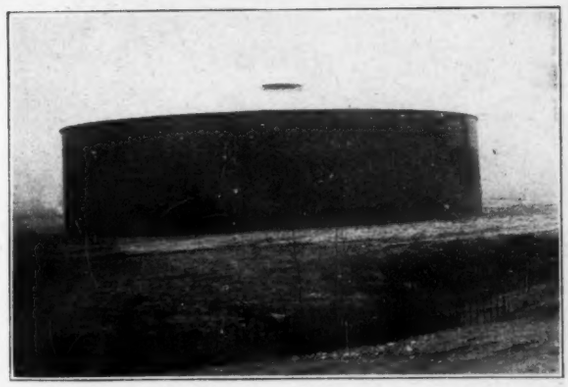
WATER WORKS AND SEWERAGE
JULY 1933
NO. 7
VOL. 80.
A GILLETTE PUBLICATION

NEW 6,000,000 GALLON WATER STORAGE TANK

Solves Distribution Problem at Milwaukee

By HERBERT H. BROWN

Engineer in Charge of Design & Construction of Pumping Stations, Water Department, Milwaukee, Wis.



Milwaukee's New Ground Storage Tank, 6,000,000 Gal. Capacity.

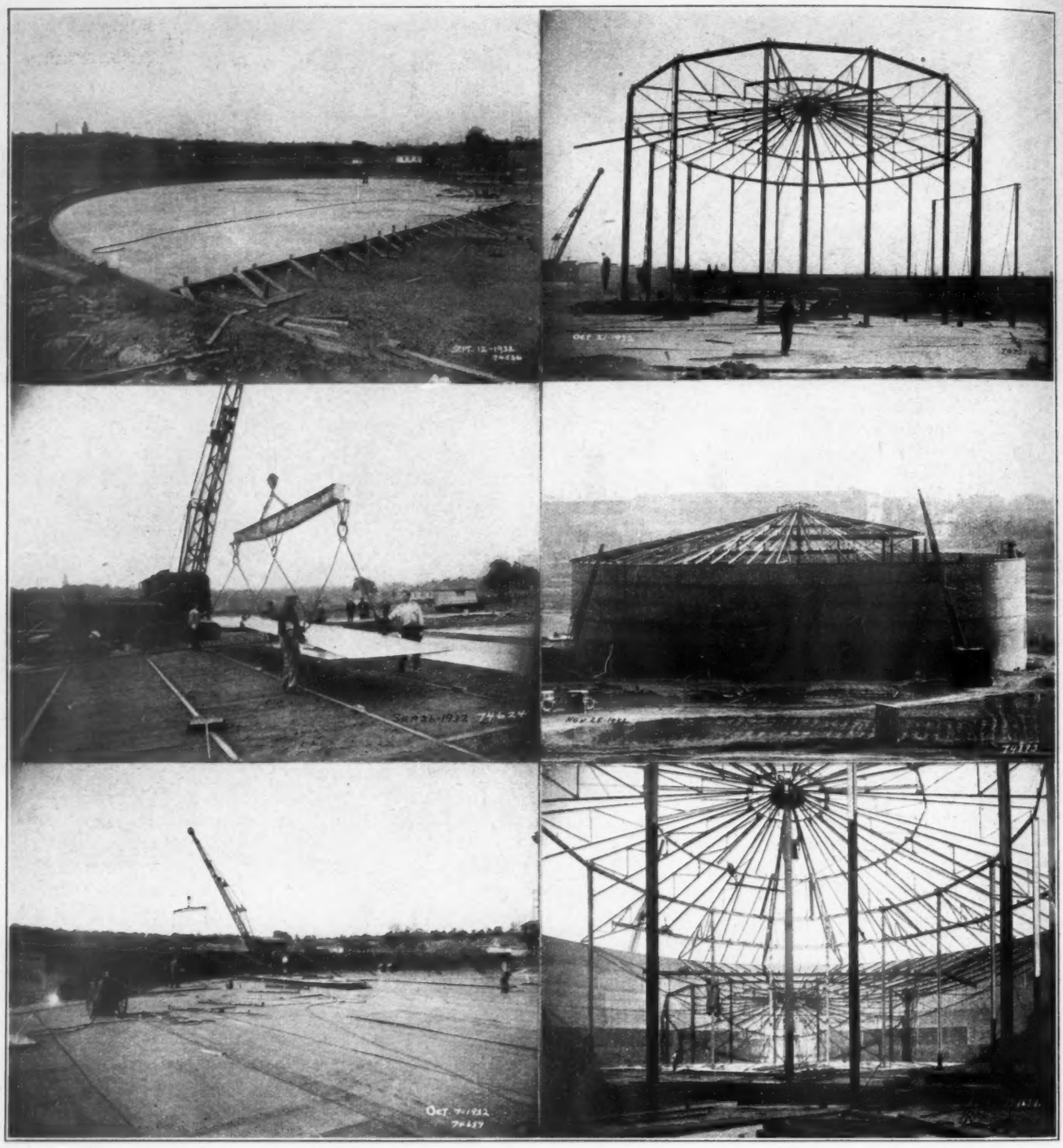
A FEW years ago the city of Milwaukee launched a program of installing elevated steel water tanks to alleviate low pressure conditions during peak load periods in the outlying sections of the distribution system. The first unit of this program was a 1,500,000 gallon elevated tank constructed in 1930. The second tank, erected in 1931, was also of 1,500,000 gallons capacity. These tanks were connected directly to the distribution system and are both filled and emptied through a single large main. They are filled during the night and the water is held in storage until the peak load hours the following day by means of special control apparatus. During the spring and fall when the peak loads are relatively small, the tanks are permitted to "float on the line." During the winter months both tanks are drained and taken out of service.

Herbert H. Brown

These elevated tanks have functioned very satisfactorily to date and have well served their primary purpose of boosting pressures during periods of high consumption. However, to continue this program of installing elevated tanks in the future would require the construction of a great number of similar installations throughout the outlying sections of the city. Difficulty has been encountered in securing satisfactory sites at sufficiently high elevations and also in overcoming the objections of nearby property owners to unsightly steel structures. Methods for future improvement of the system, which could be substituted for the plan of continued installation of elevated tanks, were therefore studied.

The first method considered was the construction of another major pumping station. If such a station were constructed near Lake Michigan, from which body of water the city takes its supply, many miles of discharge piping would have to be installed at a very large cost and the resulting high friction losses would not help pressure conditions in the outlying sections to advantage. If a major pumping station were constructed at some point close to the consumption areas in order to avoid pressure losses due to friction, then an expensive suction tunnel would be required from the station to the source of supply. So the method of installing another major pumping station was rejected because of its extremely high initial and operating cost.

A scheme was next evolved to construct a booster station at some point in the distribution system and provide sufficient storage capacity to supply the pumping equipment. Under this scheme the storage reservoirs could be placed at relatively low elevations, made of large capacity and would cost a great deal less per mil-



Views Showing Progress of Construction on the 6,000,000 Gal. Storage Tank of the City of Milwaukee.

Upper Left: Portion of 12 in. Concrete Foundation. Middle Left: Laying Bottom Plates of Tank. Note Asphalt Filler and Chill Strips. Bottom Left: Bottom Plates in Position. First Course of Shell Being Welded to Bottom Plates. Upper Right: Part of Structural Steel Erected. Second Course of Shell Being Placed in Position. Middle Right: Shell Completely Welded. Erecting Balance of Roof Trusses and Purlins. Views Taken with Telescopic Lens. Bottom Right: Interior View Taken Same Day as Photograph Above.

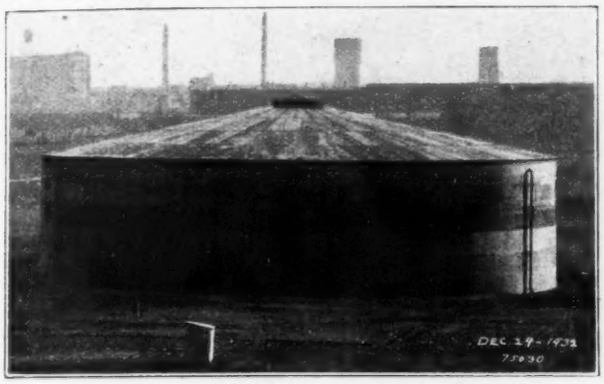
lion gallons of capacity than an elevated structure. The reservoirs could be filled during the night by the pressure in the distribution system and the pumping equipment operated the next day during peak load hours to re-establish the static head in the system. By utilizing motor driven pumps a great deal of capacity could be concentrated in a relatively small building and would require a minimum of operating personnel.

Scheme Selected

This scheme of providing large quantities of water at high pressure fit into the local conditions so well, and was estimated to be a great deal more economical than either the construction of a major pumping station or the construction of additional elevated tanks, that the method was adopted. A site was then selected for ground storage which would provide sufficient discharge capacity from the station. The leads from the station to the street will be connected to two large feeder mains which extend in three directions from the site. The pumping station will be located in the western section of the city approximately six miles from the present major stations and is ideally situated to bolster the pressures to the north and south.

The first unit of this project to be built, a 6,000,000 gallon water storage tank of steel construction, will be described in detail later. The next item of the project will be the erection of the pumping (booster) station and the installation of one pumping unit. This phase of the work will be done this year. As conditions warrant in the future, three additional pumping units will be installed and a second 6,000,000 gallon tank will be erected.

A 48-in. cast iron suction line will be looped from one tank to the other and pass through the station in a floor trench. The four pumping units will be placed on the basement floor spanning this floor trench with hydraulically operated suction valves between the 48 in. suction pipe and the pump nozzle. The pumps will be of single



View of Tank Completed Except for Painting. This Photograph Was Taken with a Telescopic Lens, the Camera Being Set Up on a Railroad Embankment 750 Ft. Distant.

stage design, each of 30 m.g.d. capacity under a total head of 250 feet. They will be direct connected to 1,500 h.p. synchronous motors operating on 2,300 volts, three phase, 600 cycle alternating current. Two separate overhead lines at 26,400 volts will be brought to the building where an interior sub-station will reduce the voltage to 2,300 volts.

In order to fill the tank, separate bypass lines will be provided between the 48 in. suction line and discharge line from each of the pumps, the connection being made on the street side of the check valves.

Description of the Tank

The 6,000,000 gallon steel tank referred to above has been completed except for painting and testing. This tank is of the ground storage type and was completely welded in the field by the electric arc fusion process. To the writer's knowledge this is the largest all welded tank of this type used in the water works field in the country. The only riveted members used on the job were the structural steel trusses, columns, rafters and purlins utilized for supporting the roof. The tank is 165 feet in diameter and is 37 feet 6 inches high to the overflow line. It is supported on a concrete slab 12 inches thick which was poured directly on the ground and pitches toward the center. The tank bottom was formed out of ⅜ inch steel plates resting on a ½ inch layer of asphalt placed directly on the concrete slab. The bottom plates were butt welded with 3 x ¼ inch chill strips placed under all joints.

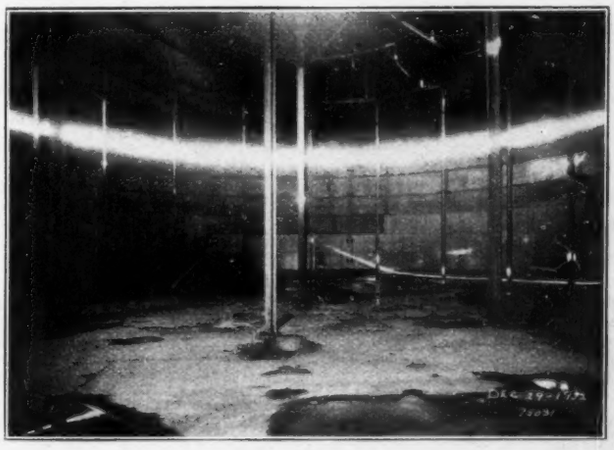
The cylindrical section of the tank is made up of six courses of plates varying in thickness from 1 and 3/16 inches at the bottom to ⅜ inch at the top. Each course is composed of 13 plates. Each plate being about 40 feet long (formed to the diameter of the tank) was placed with the vertical seams staggered in relation to the adjoining courses. A 5 × 3 × ⅜ inch shelf angle was welded to the inside of the top plate to stiffen the upper course and to act as a support for the roof trusses. The top and bottom edge of each course was machined and the machined edges of adjoining courses joined with fillet welds both inside and outside. The vertical seams are solid butt welds. Three 18 × 24 inch manholes, with the covers supported on davits, were placed in the lower course of the shell.

The roof is supported on sixteen steel trusses placed radially and all trusses fastened to one column at the center. The outer ends of all trusses are supported on the tank side. Each truss is also supported at its midpoint by an intermediate column. The base plates on all columns are welded directly to the bottom or floor plate of the tank. Rafters are framed between trusses and purlins are framed into the rafters at slightly different elevations so as to form a conical roof. Copper bearing roof plates, 3/16 inches thick, rest directly on the purlins and are designed to carry a 25 pound snow load. The roof has a vertical rise of 2 and ½ inches for each foot of horizontal length.

A pent-house, 2 feet high and 16 feet in diameter, was placed at the apex of the roof for two reasons. First, this type of construction permits a heavy wire mesh screen to be placed near the top of the tank for ventilating the interior. Second, this type of construction was adopted for architectural reasons because it was felt it will break the monotony of a large plain roof coming to an apex.

As a further method or aid toward ventilation, a ¾ inch No. 9 gauge wire screen was placed around the periphery of the tank at the top of the side walls. This screen is 9 inches in height and was tack welded to the tank plates, roof and purlins.

An overflow trough 12 × 12 inches in cross-section was formed around the entire inside of the tank. Six collecting boxes, each 10 inches wide by 12 inches high and 30 inches long, have been fastened to the bottom of the overflow trough at equi-distant points. Six overflow steel pipes, 8 inches in diameter, lead from these boxes



Interior of Tank. Note Light Glare Entering Through Ventilating Screens at Top.

through the tank wall and down to the ground where they will be connected to the storm sewer. Slip joints have been provided in the vertical run of these overflow pipes to take care of any expansion.

One 48 inch pipe will be laid between the tank and the pumping station and will serve both as a supply and a drain line. This pipe line will be installed in a concrete box tunnel under the tank foundation to a point approximately 30 feet from its center. The end of the pipe line will be connected to a cylindrical discharge basin 10 feet in diameter and 7 feet 9 inches high, the top of

which is welded to the tank bottom. This basin has been designed to permit the water in the tank bottom to be withdrawn to the lowest level possible before a swirling action creating a vortex takes place and breaks the pump suction.

Inside and outside painters trolleys have been installed on the tank. The outside trolley will ride on a Z-bar welded to the tank side and the inside trolley will ride on the edge of the vertical plate forming the overflow trough. In addition to the regular inside and outside tank ladders, another ladder was installed on the center column. This ladder will run to the pent-house above, and by means of a narrow runway and a removable section of wire screen, access is provided from the roof of the tank.

The entire tank, with the exception of the structural steel, will be sand blasted and receive three coats of paint. The first coat of paint to be applied on all steel work will consist of chromate of lead. The inside of the tank will then receive two additional coats of chromate of lead. The outside of the tank will be finished with two coats of aluminum paint. The structural steel was not sand blasted but received its first coat of chromate of lead in the shop followed by two field coats of chromate of lead. The lower side of the bottom plates of the tank have been sand blasted, primed with one coat of chromate of lead and covered with one heavy coat of asphalt paint.

The tank weighs approximately 660 tons and was furnished and erected by The A. O. Smith Corporation of Milwaukee. The contract was awarded on a cost basis for a sum guaranteed not to exceed $89,500 and with the provision that all men working on the job were to be residents of Milwaukee.

A separate contract in the amount of $8,735 was awarded for the construction of the concrete foundations and the concrete tunnel for the 48 inch supply pipe.

All of the above work was performed under the jurisdiction of Mr. R. E. Stoelting, Commissioner of Public Works and Mr. J. P. Schwada, City Engineer—the writer being in direct charge.

Acknowledgment.—The above article was prepared for WATER WORKS AND SEWERAGE in January, 1933. Being later invited to present a paper on the same matter before the recent A. W. W. A. Convention the printing of Mr. Brown's paper has been postponed at his request until now.—Editor.

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George McAneny Appointed Commissioner of Sanitation of New York City

ON April 18, 1933, Mayor John P. O'Brien signed a bill reorganizing the Department of Sanitation of the City of New York. This department was formed on December 1, 1929, being controlled by a Sanitary Commission composed of three members. The new bill places the control of the department under a single Commissioner of Sanitation for which position the Mayor selected George McAneny.

Mr. McAneny has for many years been a prominent figure in New York public life. He served as President of the Borough of Manhattan from 1910 to 1914; as President of the Board of Aldermen and Acting Mayor of the City of New York from 1914 to 1915. He has also been intimately connected for many years with the rapid transit situation in New York City. From 1921 to 1926 he served as Chairman of the New York State Transit Commission. He has been active in the field of city planning, serving as Chairman of the Board of Estimate's Committee on City Planning which developed New York's present system of zoning and building regulation. On February 14, 1933, he was appointed Chairman of the Advisory Board of City Planning by Mayor O'Brien.

Mr. McAneny has taken a keen interest in the sanitary problems of the city and has strongly advocated prompt action in the matter of treatment of sewage in New York City and the cleaning up of the surrounding waters.

Mr. McAneny's attainments have been recognized by various degrees and awards. He received the Degree of Doctor of Laws from Hobart in 1914; was awarded the Beaux Arts Medal by the French Government in 1915 for services to City Planning and Architecture in the United States and was created a Chevalier of the Legion of Honor by the French Government in 1931. He has been President of the National Civil Service Reform League since 1927.

The Department of Sanitation is one of the largest of the City's departments with a personnel of some 15,000 employes. The broad experiences that Mr. McAneny brings with him as the new head of this department augurs well for the efficient prosecution of its important work.

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Association Meetings Scheduled

Sept. 5-7—Pennsylvania Sewage Works Association. State College, Pa. Secretary, L. D. Matter, Kirby Health Center, Wilkes Barre, Pa.

Sept. 7-9—Pennsylvania Water Operators' Association. State College, Pa. Secretary, I. M. Glace, State Dept. of Health, Harrisburg, Pa.

Sept. 19-22—New England Water Works Association. Hotel Stratfield, Bridgeport, Conn. Secretary, Frank J. Gifford, Community Water Service Company, Dedham, Mass.

Sept. 21-22—Central States Section American Water Works Association. Hotel Pantlind, Grand Rapids, Mich. Secretary, B. J. Lechmer, City Water Commission, Erie, Pa.

Sept. 25-27—American Society Municipal Engineers. Milwaukee, Wis. Secretary, C. W. S. Sammelman, 4359 Lindell Boulevard, St. Louis, Mo.

Sept. 25-27—Wisconsin Section American Water Works Association. Hotel Schroeder, Milwaukee, Wis. Secretary-Treasurer, L. A. Smith, Superintendent Water Works, Madison, Wis.

Oct. 7-9—Conference of State Sanitary Engineers. Hotel Claypool, Indianapolis, Ind. Secretary, R. E. Tarbett, U. S. Public Health Service, Washington, D. C.

Oct. 9-12—American Public Health Association. Indianapolis, Ind. Executive Secretary, Dr. Kendall Emerson, 450 Seventh Avenue, New York City.

Oct. 12—Central States Sewage Works Association. Hotel Claypool, Indianapolis, Ind. Secretary, Gus. H. Radebaugh, care Sanitation District of Urbana, Ill.
(To be held simultaneously with the meeting of the American Public Health Association)

Oct. 16-19—Southwest Water Works Association. Oklahoma City, Okla. Secretary, Lewis A. Quigley, Supt. Water Department, Fort Worth, Texas.

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23 States Permit Sewer Service Charges

Sixteen states—Arkansas, California, Idaho, Iowa, Maine, Montana, Nebraska, New Hampshire, North Carolina, North Dakota, Oregon, Pennsylvania, South Carolina, Tennessee, West Virginia and Wisconsin—enacted laws in 1933 enabling cities to operate sewers and sewage disposal plants on a service charge basis and to issue revenue bonds for their construction. Under these laws, income from the self-supporting plants may be pledged as security for construction loans. This has made it possible to borrow from the R. F. C. in the past and puts cities in the states named in line for prompt financial assistance from the Emergency Public Works Administration. With the seven states which put such laws on their statute books prior to 1933, this makes a total of 23 states having enabling acts.

THE UTILIZATION OF BY-PRODUCTS OF SEWAGE DISPOSAL

By JAMES R. RUMSEY

Superintendent, Sewage Treatment Works, Grand Rapids, Mich.

The Author

WE would have preferred to use the title of "Sidelines of Waste Treatment" because, as we see it, there is some danger that the "interest in" by-products from sewage treatment may become paramount to the main problem of waste treatment, whereas, they should never be considered as more than "sidelines." In this discussion we shall not touch on any phase of treatment, but we beg of you to believe that we do not neglect, or do we intend to neglect, the main problem.

A by-product is defined as "A secondary product resulting from the manufacture of the main product," and again as "Something having a market value of its own, produced as in manufacture from material left over in the production of the chief product."

The success or failure of sidelines, we believe, rests entirely with the personnel of the operating organization, and is inspired by imagination, initiative, zeal and willingness to work on the job.

In presenting the thoughts of our organization to you, we are dividing the subject of by-products into two so-called main headings, viz.: intangibles and tangibles.

As intangibles, we list interest and enthusiasm, courtesy, good-will, appearance and research. Of these all but the last item are more or less related to one another. As tangibles, we list fuel, fertilizer, gas, power, crop production, and services.

There are probably many more divisions that could be made, but these will suffice for this discussion, providing you are willing to accept our rather liberal interpretation or what may be termed by-products, and our division of intangibles and tangibles.

Interest and enthusiasm, as by-products or sidelines of waste treatments, are products of the operating personnel.

Intangible By-Products

Interest may mean only a passive mental attitude, such as the consideration of a certain job or part of a job, but taken with enthusiasm it should mean working at such a job vigorously, both mentally and physically, in such a way that no undertaking is too difficult, and no day is too long.

Interest and enthusiasm are necessary to successful utility operation, in that, if these qualities are missing from the organization it is next to impossible to achieve the proper coördination and teamwork required to produce the desired efficiency and economy. Efficiency and economy directly affect the cost of production of by-products, as well as the cost of operation in performing the main function of waste treatment. On this basis interest and enthusiasm could well be considered as tangibles.

In an organization possessing these attributes, a working unity can be effected that will be productive of the other intangibles, that we shall mention, and try to show to be assets to the main function of waste treatment. There must be sincerity, honesty and earnestness, not only in the operation of the main function, but also in the utilization of by-products. Interest and enthusiasm are qualities of primary importance to the success of both.

Courtesy

Courtesy should be cultivated to the extent that it is practiced among the employees. It should be used impartially at all times with visitors who come with the avowed purpose of finding fault, with the time killer or the idly curious as well as with those who come for a friendly visit; with the misdirected stranger, other municipal departments, public and private utilities, and particularly in all telephone communications. A courteous and helpful answer over the telephone is an invaluable asset to any organization and a good-will builder of the first order.

Private utilities have to a large degree abandoned the "public be damned" attitude. Government in general today more or less ignores courtesy. Governmental utilities, as a general rule, are less apt to appreciate the value of courtesy than do private utilities. All public functions or enterprises need public sympathy and, therefore, public utilities should be astutely courteous and aspire to the making of friends.

If the personnel of an organization is invariably courteous, it will pay. It will thus attain a reputation for cheerfulness that is an immense asset in dealing with

Sewage Treatment Works of Grand Rapids, Mich.

Grit Handling at Grand Rapids. Grit Chamber at Right

the business and political problems that arise. In selling waste disposal service to a community the public should be made to feel that their questions will be courteously answered, and that their complaints will be attentively received. Cheerfulness and politeness constitute a by-product that is mostly psychological, but can be capitalized in many ways.

Good Will

Good will, or the kindly feeling toward you and your problem, has a distinct business value, and should be sought for.

There are so many ways to promote good-will that we hesitate to enumerate them, except by illustration of some of the instances recently experienced in our organization at Grand Rapids.

We try to be in readiness at all times to give illustrated talk on waste collection and treatment, stream pollution, gardening, new developments in treatment methods, and plant management and operation. We have appeared on seven or eight programs during the last two months and we have been generously repaid by the interest shown in what we are accomplishing and the publicity obtained.

We have made soil deficiency analyses without charge, and have been recompensed in good will through word of mouth advertising of our fertilizer.

We have worked on, and made reports of, special problems for the Administrative branch of our government, and have furnished information to other departments of other cities. We have been fully rewarded by the additional confidence placed in us, through the courtesies extended to us, and in the exchange of valuable information.

We have coöperated with concerns furnishing materials and supplies to a point where their good-will has brought us better prices and discounts.

We have had favorable newspaper editorials and news stories and favorable comments from the Administrative and Legislative branches of our government.

A great many of the advantages we have enjoyed are due to the kind feelings engendered as the result of some favor or service of our organization in the past which we were glad to grant or do.

Good will is a by-product that is quite real for an intangible, and is constantly bearing fruit.

Plant Appearance

We disagree with those who do not believe in beautification of sewage treatment works, contending that there is no aesthetic value possible in the vicinity of a waste treatment plant. We believe with Lemuel Putt that pleasing vistas are an essential part of human happiness and contentment. We believe that working in an agreeable and harmonious surrounding adds to contentment, pride and satisfaction, and, therefore, tends to build morale and efficiency.

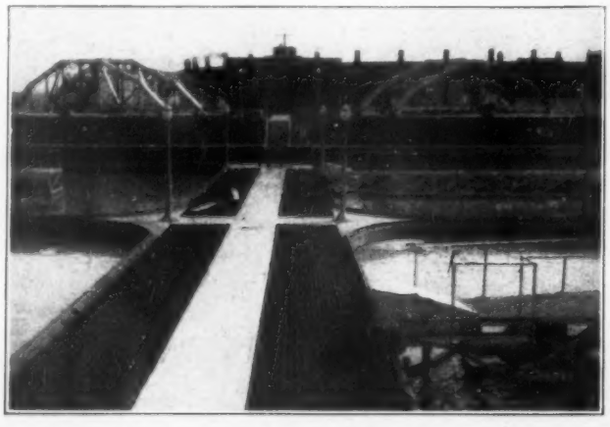
From another standpoint, we believe that the casual, as well as the technical visitor, is attracted by well kept lawns, shrubbery, flowers and trees, by cleanliness and lack of odor, and by intelligent and neat operators.

The casual lay visitor expects something repulsive on his first visit to a waste treatment plant, and if on his approach to the grounds there is a bit of harmonious floral coloring, or a pleasing setting of lawn, shrubbery and trees, then such a sight will disarray his train of thought, which may become so broken that he will notice other pleasing sights and things. He will notice that the plant is orderly, clean and odorless. If the operators, at this point, can assure the visitor that such a plant can be operated in a neat and clean manner, and at a nominal expense to the individual (in our instance 1 mill per day, or 36c a year per person), and if he can create enough interest so that the visitor will return, say to see the 2,000 tulips, the hawthorne blossoms, the roses, the water lilies, the greenhouse, the water garden, or some of the other features of appearance and interest, then we have performed a part of our duty as operators of a necessary public utility. At the same time we have created the important impression that a sewage treatment plant is not, after all, a nuisance.

Pleasing appearance is, in our opinion, the most valuable of the intangible by-products or assets.

Research and Experimentation

It is possible that research and experimentation may be a doubtful by-product in the opinion of some plant



Four Clarifiers and Four Digesters Beyond, Grand Rapids, Mich.

operators, but this is not so in the minds of our organization. We have received valuable experience and information by coöperating in the following research problems.

For the Sludge Digestion Committee of the American Society of Civil Engineers: Seven months of intensive separate sludge digester study and experimentation, as embodied in the report of the Committee, and in appendix 1 and 1A of that report.

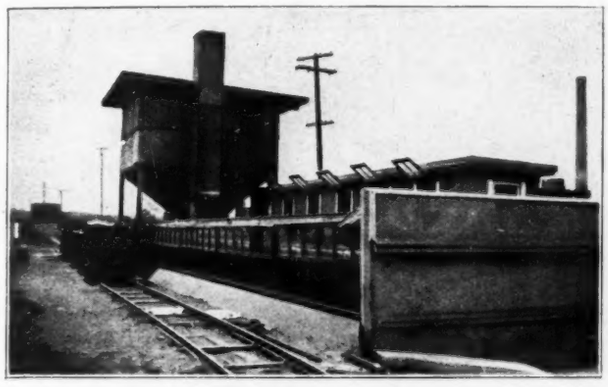
For the Engineering Experiment Station of Michigan State College: "The Disposal of Water Softening Plant Sludge at the Sewage Treatment Plant Grand Rapids, Michigan," as published in its bulletin No. 40.

For the Oliver United Filters, Inc.: "The Conditioning and Filtering of Raw and Digested Sludge."

For the Engineering Experiment Station of Michigan State College: Ferric chloride as an aid to clarification, the results of which have been published in WATER WORKS AND SEWERAGE for June, 1933.

For Rascher & Betzold, LaMotte, Hellige, Wallace & Tiernan, Youden, and Leeds and Northrup: Studies to determine a standard method of pH indications for sludges.

There have also been many other studies and experimentations of importance, aimed toward increased efficiencies of operation and better utilization of by-products.



The Fertilizer Plant

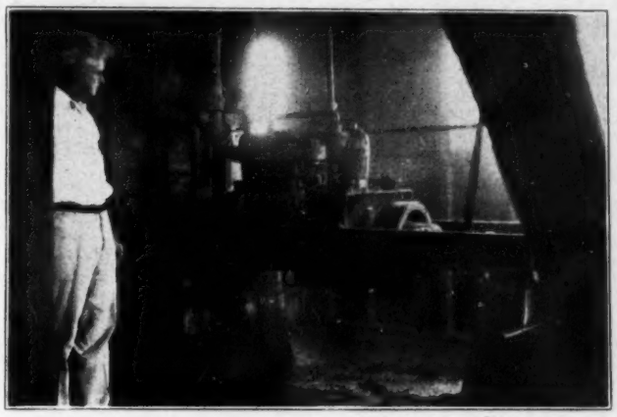
Utilitarian By-Products

Sludge and Scum as Fuel

Of the tangible by-products there seem to be some possibilities in using excess digested sludge cake as a fuel. Our own experience this past year was in firing a boiler with about 45 to 50 tons of this material. The cake had a heat value of 4,300 B.T.U.'s per dry pound, and an ash residue of about 50 per cent. We find that this fuel, when having more than a 50 per cent moisture content, will not burn successfully under a boiler. At 30 per cent moisture a good fire is maintained by somewhat frequent rocking of the grates to remove the excess ash.

Sludge cake in the bin, at our Market Avenue Pumping Station, cost about 66 cents per ton, and assuming three tons of cake equivalent to one ton of slack coal, it gives us a relative value of $2.00 per ton for the sludge cake as compared to $4.75 for coal to produce a like number of B.T.U.'s. In order to utilize any quantity of excess cake for fuel purposes, it would be necessary to provide a good size storage, as this material is quite bulky.

Another fuel source of potential possibilities is the mixing of clarifier skimmings with digester scum and drying-in our case on about three-fourths of an acre of specially prepared scum beds constructed for this purpose. As a fuel, it will produce from 9,000 to 9,500 B.T.U.'s per pound, or the equivalent of Michigan steam coal. The problem in this connection is to stabilize these skimmings and the scum, the first of which carries relatively large amounts of hydrocarbons, so that they will not give off offensive odors when dried and placed in a



Wisconsin Engine Driving Fertilizer Plant; Sludge Digestor Gas

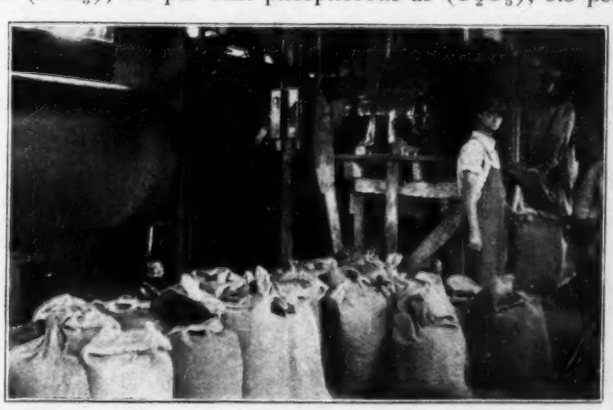
dry storage bin. There seems at present a possibility of producing 300 to 400 dry tons per year, with a value of between $1,200 and $1,500. We expect to look into further developments along this line during this year.

Sludge Fertilizer

We can best show the value of our sludge fertilizer as a by-product by relating some of the facts and developments which have taken place at our plant during the past two years.

Sludge cake, ground, dried, screened and bagged, is sold under the name of "Rapidgro," as a low grade organic fertilizer and soil builder. It was marketed this past season to the extent of about 990,000 pounds in 110-pound bags, of which about 90 per cent was sold at retail to about 3,000 Grand Rapids citizens. Our major difficulty was in meeting the demand. We were at one time 2,000 bags behind in our deliveries because of the limited capacity of our makeshift, home-made grinding and sacking equipment.

"Rapidgro" fertilizer contains 2.35 per cent nitrogen as (NH_3), 2.5 per cent phosphorous as (P_2O_5), 0.3 per



Grinding Sludge Cake for Fertilizer; Dryer at Left

cent potash as (K_2O), 33.3 per cent humus, 15 per cent calcium carbonate ($CaCO_3$), 7 per cent calcium oxide (CaO), 7 per cent ferric and aluminum oxide, and 30 per cent silica. It is used as a top dressing on lawns, and improves sandy soils by supplying plant food and improving the physical condition and moisture retaining property of such soil. In heavy clay soil it breaks up

the tenacity and makes it more penetrable for plant roots.

In 1931, 525 bags of "Rapidgro" were sold at retail, 300 tons were furnished to the Park Department, and about 100 tons were used on our own soil development projects.

In 1932, 9,000 bags were sold at retail, 56 tons were furnished the Park Department, 22 tons were experimentally used at the airport, and about 100 tons were used on our own property.

The production cost for the past year amounted to $1,575.51, and was distributed as follows: payroll $842.99, bags $453.67, delivery books and postage $133.78, machinery and repairs $133.88, and miscellaneous expense $11.19. Receipts for the year amounted to $4,331.16, and with an inventory of $3,000 the net return to date is $5,755.65.

Our price for 1931 and up to September 15, 1932, was 50 cents per bag of 110 pounds. It was then changed to 65 cents per bag delivered, 55 cents per bag at the plant, $10.00 per ton in ton lots and $9.00 per ton in five-ton lots or more.

We are now rebuilding the equipment in the fertilizer plant to double our output, bringing it up to about 1,000 tons per season, which is approximately one-third of the total sludge cake available per year.

Other than news stories carried by the local papers, our only advertising has been 1,000 postal cards sent to old and prospective customers. We hope to send out 3,000 postal cards this year, and about 250 letters to prospective users of a ton lot or more.

This by-product has proved quite successful and satisfactory by and large, and its continued development seems ideally suited to our plant both as to location and ready market. We wish to acknowledge that the original idea came from Floyd E. Brown, Supt. of Sewage Treatment Works, Marion, Ohio.

Gas and Power

Sludge gas has a number of uses, but we will limit this discussion to that use which seems to us most pertinent to our waste treatment plant.

After more than a year and a half of study, our organization has come to the conclusion that the most efficient and convenient use of sludge gas is in burning it in internal combustion engines to develop electrical power. The heat from jacket, valve and manifold cooling, and waste burned gases, can be recovered through economizers. The recovered heat is useful for heating sludge digesters, for sludge drying in fertilizer production, and for use in the hot water heating system in the plant buildings.

In general, our situation is as follows: With an average gas yield of 1 cu. ft. per capita, or approximately 170,000 cu. ft. per 24 Hrs, at 715 B.T.U. (high thermal value), the power equivalent would be 422.2 B.H.P. (at low thermal value), equivalent to 315 Kw. On a yearly basis this would be 2,759,400 Kw.H. and assuming its value at approximately 1.25 cents per Kw.H., the gross earning would be $34,946.04. Deducting $8,100.00 for annual operating cost, and $10,130.15 for fixed charges of 12.6 per cent on the installation, it leaves a net profit of $16,715.89, or 20.9 per cent on the capital investment of the proposed power development project of $80,400.00. Likewise, at approximately 1 cent per Kw.H., the gross earning would be $27,229.25, and deducting the same annual operating cost and fixed charges, the net profit would be $8,999.10, or 11.2 per cent on the $80,400.00 development expense mentioned.

The present cost of current at our Market Avenue Pumping Station is 1.26 cents per Kw.H., and at the treatment works the cost is 1.73 cents per Kw.H. At the City's Coldbrook steam plant the cost is 1.4 cents per Kw.H. Based on these unit prices it is evident that the figures of 1 cent and 1.25 cents are conservative, and that some additional advantage would be gained over and above the profits cited.

We have been experimenting with a 75 H.P. automotive engine, which will be used this year to operate our fertilizer plant.

Just recently we put into service a 600 cu. ft., 3½ lb., Connersville blower, direct connected to a 25 H.P. Buda engine, turning at 925 R.P.M. This engine, operating 92 per cent of the time on sludge gas, will create a net saving of $700 per year in current figured at 1.1 cents per Kw.H., and will cost only $1,400, including the air filter, completely installed.

Agriculture and Horticulture

Farming and truck gardening has interesting possibilities as a by-product endeavor when combined with available land, fertilizer, equipment and the urge to work.

At our plant, in the last two years, we have produced some considerable quantities of edible produce, which was devoted primarily to the use of the City's dependent families. Some of the produce raised last season, and the quantities, are as follows:

	Crates		Crates
Cabbage	655	Tomatoes	1,245
Carrots	238	Turnips	11
Cucumbers	218	Sunflower seeds	77
Potatoes	384		
Rutabagas	270	Total	3,387
Squash	289		

These were distributed as follows:

	Crates
City Store (for dependents)	2,507
Sunshine Sanatorium	142
Social Center	78
Scrip Workers	554
Park Department	98
Bonus Army	8
Total	3,387

Very likely enough additional produce was harvested, without our permission, to bring this quantity up to 4,000 crates.

It is our desire, and the wish of the Administraiton, that surplus land over and above that required for waste treatment, be worked rather than allowed to grow noxious weeds. Recently we have been authorized to plant the following:

	Acres		Acres
Early Cabbage	2	Late Carrots	2
Early Carrots	2	Late Potatoes	10
Early Potatoes	5	Winter Squash	5
Sweet Corn	5		
Tomatoes	3	Total	36
Late Cabbage	2		

The four acres devoted to early cabbage and carrots will be used also for a late crop, such as turnips or rutabagas. In addition, fourteen acres of new land will probably be broken up and used for a late crop, such as winter cabbage, late potatoes, turnips or rutabagas.

Eventually, and particularly after the present emergency, these lands will be devoted to crops producing a revenue that will exceed the cost of production. At present the production cost has not been considered because we have been using welfare labor in part.

We also maintain a nursery of about 10,000 plants, mostly Jack pine, red pine, Norway spruce, red oak, walnut, willows, and ornamental shrubs. This is probably the biggest money maker we have, as the profit per acre from seedlings to transplants during the past 4 years has been quite considerable.

A four acre orchard is being developed. It will contain 242 fruit trees, including apple, pear, plum and apricot.

These projects are not hobbies in any sense and it was only after considerable thought and study that we decided to go into them. They seem, on first thought, somewhat removed from the practice of waste treatment, but in addition to their value as a demonstrative advertisement for our fertilizer, they were planned for a definite cash profit.

Services

In defining services as a by-product, we mean the services we render to corporations and individuals outside of our municipal boundaries, and from whom we derive a revenue.

We treated the sewage of the city of East Grand Rapids at our plant, and were paid $3,000 by that community for this service during the past year. Handling sewage from other corporations such as Kelvinator, Sunshine Sanatorium, Juvenile Detention Home, Corduroy Tire Company, Marywood Academy, etc., together with some individuals, produced a revenue of $929.41. It is our intent during the coming year to solicit sewer connections immediately adjacent to our boundaries and thus produce additional revenues from this source.

Total income from all sources, during the past year, amounted to $8,798.64 or 18.3 per cent of our total operating cost for 1932, and with inventory added it amounted to 24.5 per cent of operating cost, all of which we think is a fair start toward self support. Our dream, and the end toward which we are working, is to operate our plant without funds from the General Property Tax. Our reduction in cost of operation, for a period of twenty-nine months, has been 52 per cent, and for the coming year we anticipate a reduction of 61.7 per cent. Further reductions in the future must be made largely from by-product earnings.

Before closing I wish to assure you that the points here brought out are the products of the united thought of our whole organization, of which the speaker is merely the dreamer and the mouthpiece.

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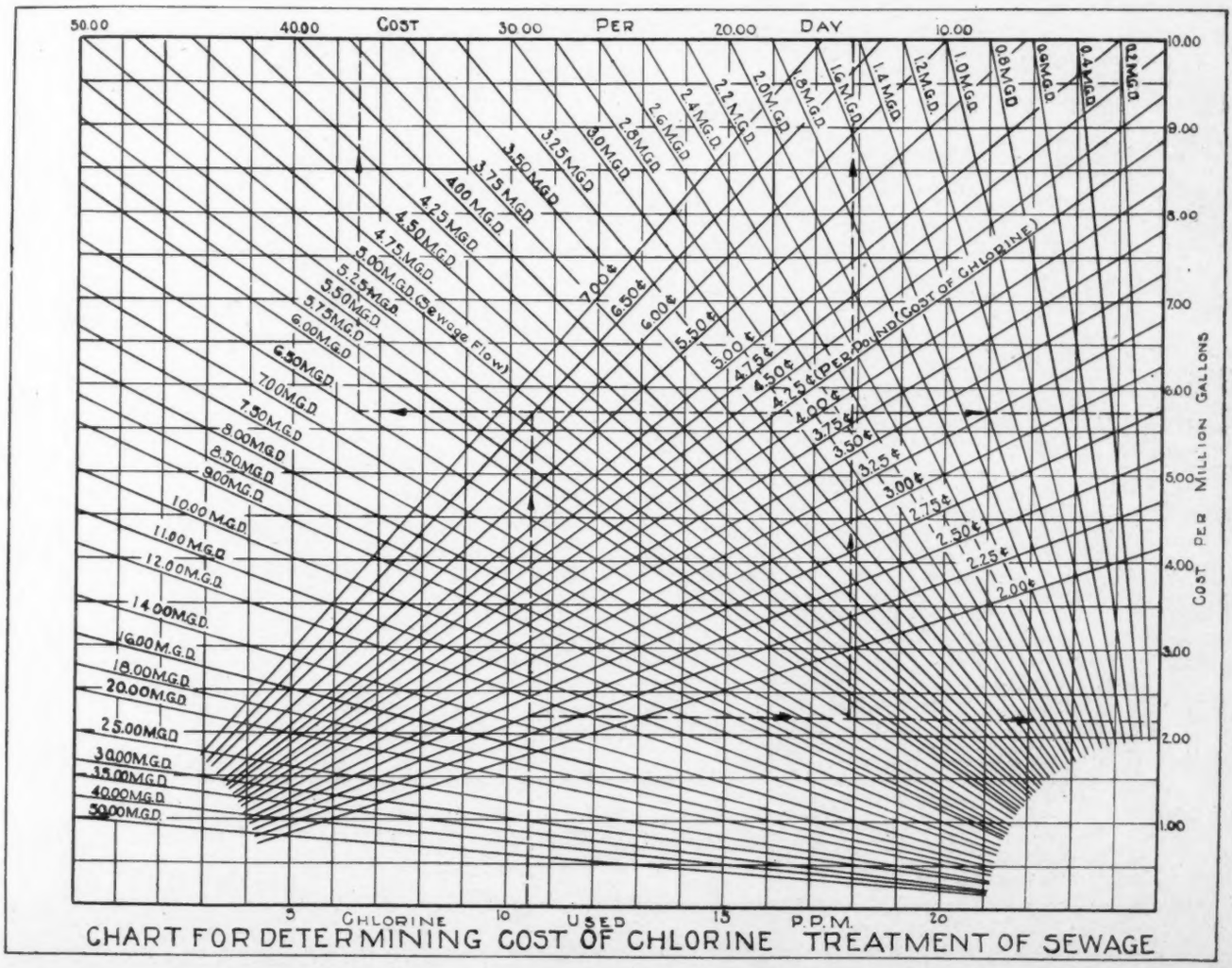
Diagram for Cost of Sewage Chlorination

By C. E. Keefer,
Principal Assistant Engineer,
Bureau of Sewers, Baltimore, Md.

Where the chlorination of sewage is either contemplated or in use at a treatment works it frequently becomes necessary to calculate the cost of chlorine used. These costs can readily be determined by the accompanying diagram. For example, assume that 6.5 m.g.d. of sewage is to be treated with 10.5 p.p.m. of chlorine, costing 6½ cents per pound. From the diagram it is seen that the chlorination costs $5.70 per m.g. or $37.00 per day. Or if the chlorine, purchased in one ton containers, cost but 2½ cents per pound the cost will be $2.20 per m.g. or $14.30 per day.

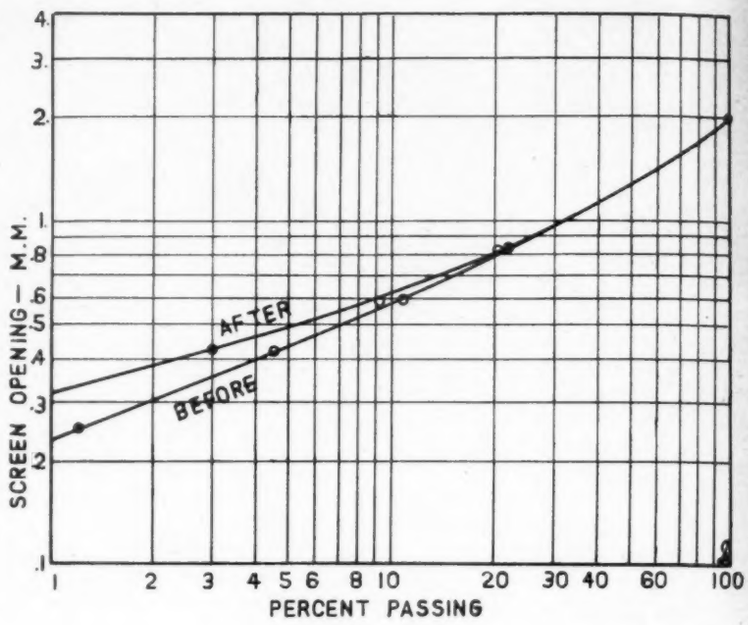


ATTRITION LOSS OF ANTHRACITE IN RAPID FILTERS

By HOMER G. TURNER[1] and GEORGE H. YOUNG[2]

IN the backwashing of rapid filters, the particles of the filter medium are subjected to rubbing and impact, which in addition to cleaning the particles, may cause some degradation, with a corresponding loss of fines so produced. There has been some speculation as to what would be the economic aspect of this degradation where Pennsylvania anthracite is used as a filter medium. The following study was made in order to answer this question in a practical way without going into details as to the hardness or toughness of the materials used.

The experimental procedure follows: A Pyrex glass tube 1½ inch inside diameter was clamped in a vertical position. A 20-mesh iron wire screen was fixed in the bottom of the tube above a rubber stopper. A ¼ inch glass tube passed through the rubber stopper and was connected to the tap. A copper wire screen 0.16 mm. linear opening was fixed in the top of the tube, below a rubber stopper. A ¼ inch glass tube passed through this stopper, and was connected to a rubber tube leading to the drain. Approximately 200 grams of anthracite was sized carefully, then placed in the Pyrex tube. The tap was opened and regulated until a 50 per cent expansion of the filter bed was obtained. Thereafter, slight adjustments were made in the tap valve whenever necessary to maintain the 50 per cent expansion. At the end of 14 days, the anthracite was removed from the tube, dried, and again carefully sized. The sizing results are given in Table I, and shown graphically in the accompanying chart.



Sizing Results for Anthracite

TABLE I

Sizing Data

Screen Mesh	Before Backwashing Opening per cent % by Size	MM.	Passing	After Backwashing Opening per cent % by Size	MM.	Passing
Over 10 m.....	1.0	....	....	1.0	....	....
10 x 20 m.....	76.8	2.00	99.0	78.6	2.00	99.0
20 x 30 m.....	11.4	0.84	22.2	11.2	0.84	20.4
30 x 40 m.....	6.3	0.59	10.8	6.2	0.59	9.2
40 x 60 m.....	3.3	0.42	4.5	2.6	0.42	3.0
Thru 60 m.....	1.2	0.250	1.2	0.4	0.250	0.4
	100.0			100.0		
Effective size				0.58		0 61
Uniformity coefficient				2.50		2.38

Table II shows the same data on an actual weight basis.

TABLE II

Screen Mesh	Weight in Grams—Weight Before Backwashing	Weight After Backwashing	Loss in Weight	Per Cent Loss in Weight
Over 10 mesh.....	1.9	1.9	0.0	0.0
10 x 20 mesh.....	151.3	151.1	0.2	0.1
20 x 30 mesh.....	22.5	21.6	0.9	4.0
30 x 40 mesh.....	12.5	11.9	0.6	4.8
40 x 60 mesh.....	6.4	5.1	1.3	20.3
Through 60 mesh...	2.4	0.7	1.7	70.8
Totals.....	197.0	192.3	4.7	2.4

(1) Director and (2) Assistant Director of Research for the Anthracite Institute, School of Mineral Industries, The Pennsylvania State College, State College, Pa.

From an inspection of Table II, one can readily see the attrition effect on the various individual sizes, and perhaps form a clearer conception of what happens than from the sizing chart.

Considering these results in the light of replacement cost in filter plant operation, the indications are that losses resulting from backwashing would be practically negligible. Assuming five minute washing periods, and 24 hour filter runs, there would be a loss of 2.4 per cent of filter material in eleven years, or about 0.2 per cent per year. Based on a 12-hour filter runs the loss would amount to about 0.4 per cent per year. For other lengths of filter run and washing periods, the loss can be figured as above on a proportional basis.

The writers desire to acknowledge the cooperation of the Mineral Industries Experiment Station, The Pennsylvania State College.

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Birmingham's New Sewage Treatment Plant in Operation

The new 12 M.G.D. sewage treatment plant recently completed as a part of the Ensley project in Birmingham, Alabama, has been placed in operation and the plant of the Bessemer project (16 M.G.D.) is nearing completion. The treatment at the latter plant will, for the present, consist of fine mechanical screening and chlorination. The Ensley plant provides screening, grit, removal, sedimentation and separate sludge digestion.

H. H. Hendon, Sanitary Engineer of Jefferson County, has had charge of design and construction of the Birmingham sewerage improvements and Fuller and McClintock Engineers, served as consultants on both projects.

THE 53RD CONVENTION OF THE AMERICAN WATER WORKS ASSOCIATION

Discussion of the National Recovery Act and Methods of Stimulating Public Utilities Construction, a High Light of the Convention

THE 53rd Annual Convention of the American Water Works Association was opened by President George W. Pracy at the Hotel Sherman in Chicago on June 12th. In his brief but timely opening address he presented the President-Elect, Malcolm Pirnie, as a member of the association since 1917 and a man who has done perhaps more than any other member for the good of the association. He said that the association owed Mr. Pirnie a debt of gratitude for his work in connection with the national rehabilitation program which had given such an important place to public works construction as a stimulus toward industrial recovery and unemployment relief.

Secretary and Treasurer's Reports.

The Secretary's report, presented by B. C. Little, indicated a loss of 327 members during 1932, leaving a membership of 2,390 as of January, 1933. The annual cost of printing the Journal and running the association had been $69,700, which was somewhat less than the association's income. This in the face of reduced income of $4,500 by loss of dues plus $5,500 due to loss of advertising.

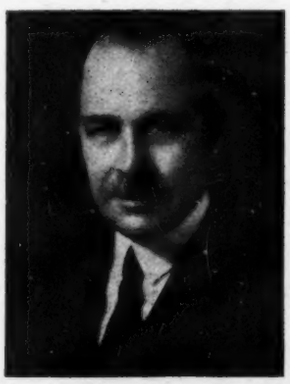
In presenting the Treasurer's report, Mr. Brush stated that investments and cash on hand as of June 1, 1933, totaled $42,336, which represented a decrease of $754 for the year. Invested funds ($30,000) had yielded an income of $4,315 during 1932 and the finances of the association remained in a sound condition notwithstanding loss of gross income.

Presentation of Medals

The John M. Diven Memorial Medal was presented to S. B. Morris, Chief Engineer and Manager of the Pasadena (Calif.) Water Department, as a member who had done a great deal for the good of the association, both in connection with the California Section and the parent association, and was highly deserving of this recognition.

The John M. Goodell Award for the most meritorious paper published in the Journal of the association during the year was voted to Chas. H. Spaulding, Superintendent of Water Purification, Springfield, Ill., for his paper on the quantitative evaluation of odors in water—(Journal A. W. W. A., August, 1933).

George W. Pracy (Retiring President), Superintendent Water Department, San Francisco, Calif.



Malcolm Pirnie (President-Elect), Consulting Engineer New York City

Memorial Exercises at the Old Water Tower: Dedication of Plaques Placed in Honor of Three Former City Engineers of Chicago—Chesbrough, Creiger and Ericson—All Leaders in the Development of Chicago's Water Supply System, During 102 Years of Combined Service

An honorary membership was bestowed upon Mr. Alexander Milne, Superintendent of Water Works at St. Catharines, Ontario, who was introduced to the members by A. U. Sanderson, chairman of the Canadian Section of the association, as a member since 1903, the organizer of the Canadian Section and a past president of the A. W. W. A.

Former City Engineers of Chicago Memorialized

Fittingly, at the "Old Water Tower" which is now a land mark in Chicago, memorial plaques were dedicated to three former City Engineers of Chicago, Ellis S. Chesbrough, Dewitt C. Cregier and John E. Ericson, who had played such important parts in the development of Chicago's water works system. At these exercises addresses were made by President Pracy, Chas. B. Burdick of Chicago and Myron B. Reynolds, Chicago's present City Engineer, Mayor E. J. Kelly and others.

Exhibit Contest Repeated

The ballot voting by members for the most instructive and best arranged exhibits at manufacturers booths, which was so successfully held at the Memphis convention last year, was repeated at Chicago. The ruling made, that the same exhibitor could not be given first award two years in succession, prevented Wallace & Tiernan Co. taking first place, which the count of votes showed they had won. First place thereby went to the close second, International Filter Company. The Dorr company won second place, and third place went to The Meuller company. The Wallace & Tiernan Co. exhibit featured "One Fifth Century of Progress in Chlorination," in which was shown the first "W. & T." chlorinator, which was built in 1913, alongside the latest

Diven Medalist: Samuel B. Morris, Chief Engineer, Pasadena, Calif., Water Department. Sam Thought He Didn't Deserve It, but No One Would Agree With Him

Chas. H. Spaulding, Superintendent Water Purification, Springfield, Ill. Recipient of the John M. Godell Award for 1933

1933 models, including the new "Chlorinator Monitor" for providing remote chlorinator control.

New Division Chairmen

The following were named chairmen of their respective divisions by the nominating committees:

Management and Operation—Carl Heckmer, Washington Suburban Sanitary District, Hyattsville, Md.

Water Purification—George D. Norcom, Federal Water Service Corporation, New York City.

Finance and Accounting—E. E. Bankson, C. E., J. N. Chester Engineers, Pittsburgh, Pa.

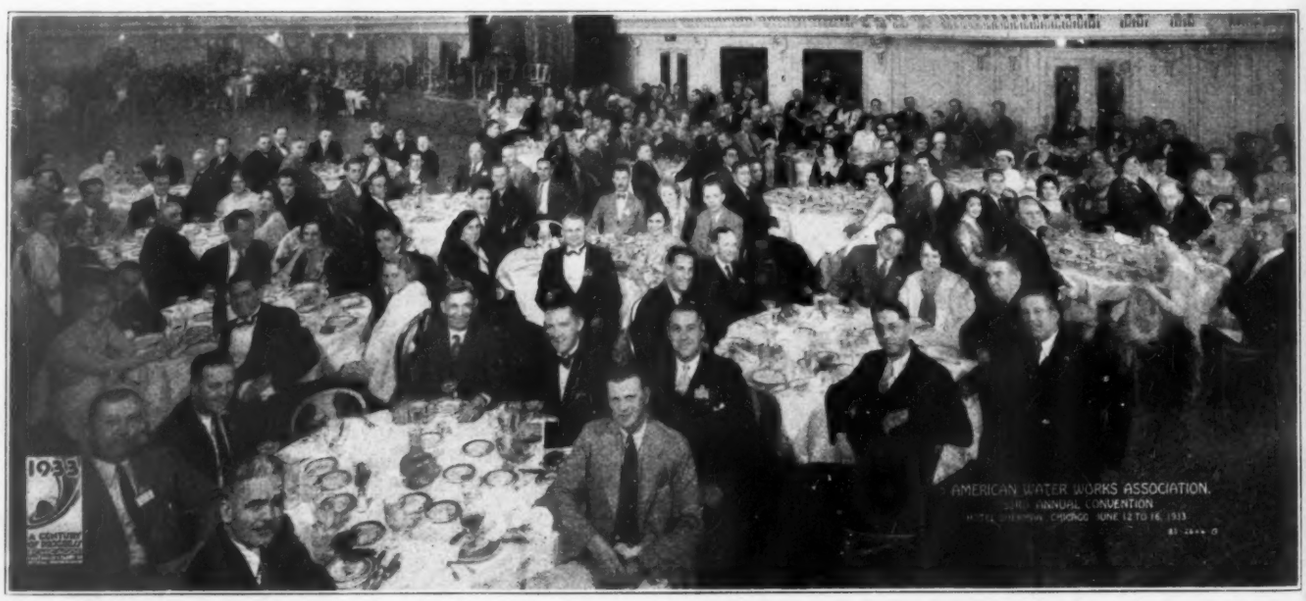
Public Works Program Occupies Center of Stage

The most important and best attended session of the convention was that devoted to an analysis of the Public Works Section of the National Industrial Recovery Act, which was passed by Congress and signed by President Roosevelt during the convention.

One of the most outstanding addresses ever made before an A. W. W. A. convention was delivered by Col. W. T. Chevalier, publishing director of Engineering News-Record. His subject was "The Place of Public Works in the Economic Scheme," in which he stressed the point that public works could be made productive and that the success of the National Industrial Recovery Act hinged on the ability to create employment and to help the *capital goods* industries which in turn would eventually help the *consumer goods* industry. The new Administration in Washington was, he said, appreciative of the fact that government money could be safely employed in public works construction without creating over production of capital goods which being of a durable nature, would serve the taxpayers for years to come. Title 1 of the Act had been necessary to control industry during the period of increased buying which the construction of public works would bring about, but the real success of the whole scheme would depend upon the quickness with which public works construction and betterments proceeded. It was essential that the program prove profitable in turn to private industry and that necessitated some control of competition and ruinous price cutting, which had become too prevalent in the last few years for the good of the country. "Chiseling" or cut-throat methods used in purchasing materials, he said, would defeat the purpose of the program and should not be tolerated.

When realizing that 30 to 40 per cent of our population is normally devoted to the production of machinery, equipment and materials utilized in producing capital goods and permanent facilities it was easily realized that $3,000,000,000 put promptly to work would create anew the employment which has been lacking in such industries during the past few years of inactivity. Direct relief having proved a failure, it was now apparent that the proposed program of procuring something durable, for the money to be used in unemployment relief, was the sound solution to this problem. To make it a success the object of the Act—that of creating buying power—must be promptly put into effect through normal channels which included paying fair prices for equipment, materials and labor.

Engineers, superintendents and other officials connected with public works had the power to make the program over or to allow it to become a failure and effective action was needed to put to work promptly the financial resources now made available. Their responsibility included promptness of action, the avoidance of "chiseling" methods—now too prevalent—and a return to normal methods of purchasing and contracting.



Banquet at 53rd Annual Convention of the American Water Works Association, Hotel Sherman, Chicago, Ill.

How the Act Will Be Administered

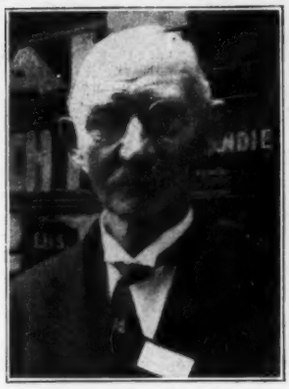
Malcolm Pirnie was requested to outline the procedure of administering the National Industrial Relief Act.

Mr. Pirnie, having had an important part in the drafting of the Act, was well qualified to explain the proposed administration of it. He said that its administration would be decentralized and that district administrators are to be appointed so as to more effectively handle the applications for loans and reduce time required.

An important revelation was the fact that the 25 per cent grant from government funds might be used to pay interest and amortization during the first five years following the granting of a loan. Furthermore, the 75 per cent of the project cost borrowed could be paid off over a 25-year period—the rate of interest being but 3.5 per cent and amortization spread over a like period at the rate of 2.5 per cent. The result, when taking into count the grant of 25 per cent, would be a net rate of but 4.5 per cent on a 25-year loan, rather than the apparent 6 per cent. Equally as attractive is the net result that the borrower gets its project paid for over the 25-year period at a total outlay of but 1.14 times the cost of the project. Such an opportunity might be termed a genuine bargain when it is realized that it costs strong financial cities, such as Toronto, 1.60 times the actual investment made to construct public works on borrowed money.

Mr. Pirnie further explained that wherever municipalities are already too depleted financially to qualify for the relief loan, the government will build and lease utilitarian works to the city at the same cost for financing, but in such cases the grant of 25 per cent will not be allowed. Thus the cost to the city without security will be at the rate of 6 per cent for interest and amortization instead of the 4.5 per cent. Communities not prepared to start work immediately may obtain funds for making preliminary studies, preparation of plans and other advance work.

Mr. Pirnie explained that during the convention secretaries of many of the sections of the association had been called into meeting in Chicago and plans were made to have these members assist municipal authorities in their territory to get through applications for loans and otherwise assist in speeding up the program.



Alexander Milne, Superintendent Water Works, St. Catharines, Ont., Upon Whom Was Bestowed an Honorary Membership

Fred Cunningham, Chairman of the Publication and Program Committee of the American Water Works Association

In the end analysis it was a matter of "first come, first served," so far as the Administration was concerned and therefore prospective borrowers should make ready immediately.

George W. Fuller, in speaking of **"The Engineer's Relation to the Act,"** felt that methods of procedure would determine the success of the program and team-work was all important between engineers, municipalities and manufacturers. There was ample room for improving existing water supplies and enlarging reserve supply. When one large city could reduce its insurance bills $100,000 per year by improving fire reserves and pressures, there seemed ample opportunity for others to profit similarly.

Dennis O'Brien, in speaking from **"The Manufacturer's Point of View,"** called attention to "the greener fields"—referring to the water works field—which would prove attractive to newcomers not heretofore serving that field. These interlopers would likely fade out of the picture after skimming the cream and should not be encouraged to produce a lot of equipment to become orphaned on the hands of the buyer in future years. The "chiseler" would defeat the entire purpose of the Act and he with the interloper must be dealt with as deserved. Municipal, as well

Banquet at 53rd Annual Convention of the American Water Works Association, Hotel Sherman, Chicago, Ill.

as private business, must proceed through normal channels again in order to be effective in creating the situation aimed for.

"What the Secretaries of Local Sections Can Accomplish" was commented upon by **H. G. Baity,** Dean of Engineering at the University of North Carolina and Secretary of the North Carolina Section. He said that the emergency meeting of sectional secretaries called in Chicago had revealed that $300,000,000 worth of improvements and new work in the water

H. F. Blomquist, Superintendent City Water Works, Cedar Rapids, Ia. Retiring Chairman of the Plant Management and Operation Division

Carl Heckmer, Engineer, Washington Suburban Sanitary District, Hyattsville, Md.—the New Chairman of the Plant Management and Operation Division

works and sewerage field was badly needed and ready to go. There existed considerable inertia to be overcome, however, in getting local authorities and taxpayers to fully realize the true value of the public works program and persuade them that it would be an economcial way out of the present situation. He felt that the sectional secretaries could do much to stimulate interest and create public demand for public works by directing and assisting in local publicity, making addresses to taxpayers' meetings and by other means. He felt that this work would be the most important job that he and his associates could undertake and was ready to "go to the front" immediately.

H. T. Munn, speaking for the National Fire Underwriters, said that his association and the State Rating Boards could render reports to municipalities to show need for improved fire protection and would be pleased to assist in that direction.

Patrick Gear of Holyoke, Mass., was called on to speak from the Water Works Superintendents' point of view. He agreed that the city needing improvements and financial assistance should grasp this opportunity promptly.

Superintendents and Managers Discuss Management and Operation Problems*, Chairman H. F. Blomquist, Supt. Water Works, Cedar Rapids, Ia.

The first session of the Division of Maintenance and Operation was largely devoted to a discussion of good-will, complaints and policies pursued in connection with delinquent bills under present conditions.

"Consumers' Good Will, Its Value and Method of Promotion"—Frank C. Jordan, Secretary, Indianapolis Water Company.

Mr. Jordan outlined methods followed by his company in the matter of building good will of the consumer and which is equally important, of holding it. He said that "good will" has as its foundation integrity of service. No business maintains a more intimate contact with the home than does the Water Department and customer's good will might be divided into two grades—passive and aggressive—and that it was most usually the former. Good-will or ill-will was usually made in the front office of the utility and not in the private office. Men at the cashier's window, at the complaint desk, meter readers and service men were the ones who could do most in building up good-will or breaking it down. Good-will would first start with rendering satisfactory 24-hour service and a pleasing product to the consumer. Thereafter, publicity would prove helpful in bringing home to the consumer what the Water Department is doing and arranging for group inspection trips through the plants. He told of the training required of meter readers so that they would be familiar with practices and policies of his company before having them contact the consumers. They must be familiar with the operation of the plants and pumping stations in order to be intelligent in their remarks and conversation with the public. Meetings of employees at which papers are read had been held at regular intervals. Men in the office are taken out on jobs to become better acquainted with the difficulties of the outside forces. He referred to the interesting things learned by the men and told in the meetings referred to, one in particular being the sprinkling of talcum powder in toilet flush tanks in order to show the consumer that the fixture was really leaking, although not apparently overflowing to the eye. The talcum powder travels across the surface to the overflow at a visibly rapid rate. Such a demonstration would remove argument and distrust on the part of the customer and was just one small incident going toward making good-will. The Indianapolis records had shown that 90 per cent of the leaks discovered had been from toilet flush tanks.

Dale L. Maffitt, manager of the Des Moines (Ia.) Water Department, said that beautification of grounds and construction of attractive tanks, such as the Allen Hazen Memorial Tank, had helped them considerably in building good-will. Another helpful move had been the removal of the grille in front of the cashier and others in the front office, and this small thing had removed an important psychological barrier between customer and the water works employee. The customers liked it.

David A. Heffernan, Superintendent Water Works, Milton, Mass., said that syphon type toilets were the most difficult to find a leak in. His inspectors were all registered plumbers and, being trained, frequently located leaks that ordinary plumbers had not detected.

Running Water Cures Insomnia at the Cost of Good Will

An amusing incident was related by a member who had been able to explain a complaint of a large water bill only after some detective work. An old lady from New York City had been on a visit to her son. It was proven that he had no leaking fixtures, but it seems that she had had a constantly leaking fixture in her New York house (page Mr. Brush), and being so accustomed to hearing the trickle of water could not sleep in her son's home until she had opened a bath room faucet slightly before going to bed each night. (The member did not explain what was employed as the substitute cure for insomnia.)

"Consumers' Complaints and How to Meet Them"—E. F. Dugger, General Manager, Water Works, Newport News, Va.

*A digest of papers presented before the Water Purification Division, prepared by John R. Baylis, Associate Editor, appears elsewhere in this issue.—Editor.

Mr. Dugger said that the use of powdered carbon to remove taste and odors from the Newport News supply during algae season had done much to clear up complaints of a serious nature. They had employed it continuously since, except for the winter period. Extension of credit to delinquent customers had created considerable dissatisfaction on the part of others who had previously been forced to pay promptly and this situation constitutes a real problem at present.

Regarding complaints of error in meter reading or registration, they had found the use of the straight reading meter, whereby the customer can take check readings for his own satisfaction, very helpful in reducing complaints. Inspections are made upon complaint of low pressures and the consumer is carefully shown the extent of pressure and flow from a standpipe connected near the meter and the trouble is then located on the premises. If the customer demands a meter test he is required to personally witness it in the shop. This plan had been very effective in reducing demands for tests. From 12,000 active services 62 meter tests were made in 1926 whereas in 1932 only 15 had to be made.

In reply to a question, Mr. Dugger said that water was being supplied to 900 families without collections and constituted a serious problem for the future in the way of collecting later.

E. A. Munyan, manager of the Union Gas and Electric Co. of Cincinnati, Ohio, said that he had had opportunity to observe that complaints from water consumers do not usually receive the same attention as those received by gas and electric utilities and that he had found that nothing was more progressive than careful, prompt attention to consumer's complaints.

Discussing methods of clearing house service lines, **D. A. Heffernan** described the practice of forcing through candy gum-drops from the premises back into the water main. It had proved very effective. In some instances balls of fine tissue paper had been used for the purpose but the gum-drops would dissolve more easily in the main.

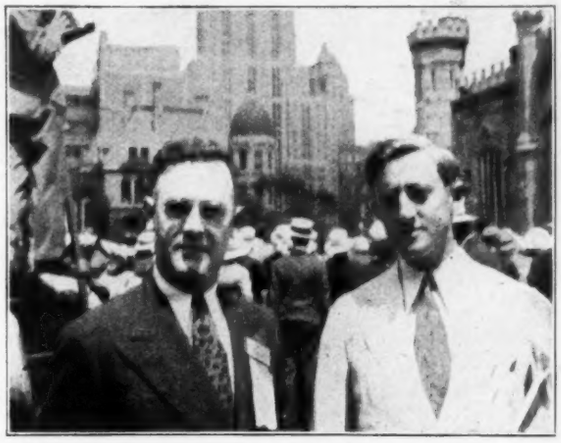
The Problem of Delinquent Water Bills

"Policies as to Delinquent Water Bills Under Depressing Conditions"—M. F. Hoffman, Assistant Superintendent Water Works (Commercial Division), Cincinnati, Ohio.

Mr. Hoffman was unable to attend the convention and his paper was read by James E. Gibson, Manager of the Water Department, Charleston, S. C. Mr. Hoffman stated that it was considered more important by his department to carry a few delinquent accounts on the ledger than to destroy amicable relationships between the water department and the consumer by too rigid enforcement of collections. Their plan had been to send out delinquency notices ten days after payment of quarterly bills had come due. After another ten days the account was turned over to the turnkeys for collection. A charge of $1.00 for collection was made and upon failure to pay, the water was turned off. Out of 10,000 accounts 8,500 would pay during the first ten days, 250 accounts would have to be collected by the turnkeys, and six out of the 10,000 would require cutting off of service. The remaining 1,244 would pay before expiration of the final ten days of grace. When a tenant fails to pay a water bill it is collectable from the owner of the property. Mr. Hoffman stated that in deserving cases the time limit for payment had been extended some. During the bank holiday checks were accepted subject to future collection. The stub plan of accounting allowed partial payment entries, whereas the ledger system did not.

Mr. Gibson stated that Charleston had been less successful in making collections than had Cincinnati. Partial payments on unpaid bills had been allowed but this practice had added to the costs by overtime work required. Favors in respect to delayed payments had been asked by persons proven able to pay up and in such cases the water had been promptly cut off.

D. C. Groebel of the Detroit Water Department presented the following facts concerning delinquency in Detroit. On Jan. 31, 1932, of the water delivered 10.5 per cent had not been paid for and represented 22.4 per cent of the accounts. On April 30, 1932, the number of delinquent accounts had risen to 69,619 (25.6 per cent), but since business conditions had begun to improve the number of delinquents is being gradually reduced. Rather than invite epidemics they had preferred carrying the delinquent accounts.



Arthur Gorman, Executive Secretary of Committee on Convention Arrangements, and Abel Wolman, Editor of the Journal

J. W. McEvoy, Superintendent of Water Works, Dubuque, Ia., reported the employment of 1,200 men at 35 cents per hour to work out their water bills. That was 10 cents more than the 25 cents being paid by contractors at that time.

Phil Carlin, Superintendent at Sioux City, reported that they had done likewise, paying 45 cents per hour.

C. M. Crowley, Water Registrar of St. Paul, Minn., said that they fortunately had been able to collect all but $600 of the 1932 water rents.

In order to prevent hardship, one member reported that his department had provided faucets on fire hydrants so that water was obtainable by those having been shut off for non-payment. Rather than carry water through the street some had paid up back bills.

Metering Practices

"The Use of Several Smaller Meters vs. One Large Meter on Large Services"—H. L. Monroe, Superintendent of Water Works, Pontiac, Mich.

In the absence of the author the paper was read by Thos. J. Skinker, Engineer in Charge of Distribution, St. Louis, Mo. Mr. Monroe set forth reasons for preferring two or more smaller meters on important services rather than depend on one large meter. When flow conditions changed he pointed out that it would be necessary to go to the expense of replacing large meters with smaller ones, whereas with a battery one or more could be removed or replaced, as the case demanded. With smaller meters all flows

would be registered and the expense of handling would be less. Further, in case of removal of meters for repairs the battery scheme would make it possible to always maintain a metered service while making repairs. Service charges, when based on size of meters installed, become more flexible if multiple metering is practiced.

Mr. Skinker, in discussion, stated that in St. Louis it was always the practice to install meters of smaller size than the service line and the better practice involved a study of the characteristics of the service to be rendered before making a decision as to the type and size of meter to be installed. When employing a single or compound meter for variable service he urged the checking of average consumption to avoid its being near the change-over point on the meter because near that point loss of revenue results. On certain large services he had with benefit installed a compound and fire service meter in parallel.

Howard Griswold, Deputy Chief Engineer of Water Works, Hartford, Conn., said that he would like to confirm Mr. Skinker's remarks concerning the loss of revenue through the use of compound meters when operating near the change-over point, and care, therefore, should be exercised in the selection of such meters.

John Chambers, Chief Engineer of the Louisville, Ky., Water Department, said that they had employed batteries of 3-inch meters and he further commented that the consumer would be satisfied with the size of service pipe installed, whereas the meter installed might be of the size deemed advisable by the Water Department.

C. M. Ginter, Superintendent of Water Works at Harvey, Ill., said that the battery idea was appealing to him at present because Harvey has a number of services supplied through 6-inch compound meters which might better have been supplied through a battery of smaller meters, some of which could be removed and thus avoid the necessity of replacing the existing larger meters now at added expense. He referred to the successful adaptation of the battery principle at Madison, Wis.

W. W. Brush said that metering of industrial services is required in New York, but for all others metering is optional. The consumer must purchase and install the meters and such a situation is difficult. Change of meters is required by the Water Department of consumption characteristics change and there are some battery meter installations. On the whole the New York system is not efficient and meters should be owned by the city.

Lewis P. Andrews, Manager of Water Department, Sedalia, Mo., stated that the Water Department owns all meters. They have installed several batteries of meters and find their operation has created good-will amongst the consumers so served.

"Measurement of Small Water Flows"—Dale L. Maffitt, Manager of Water Works, Des Moines, Ia.

It being increasingly important to have meters capable of measuring small water flows, Mr. Maffitt reported that some study had been given the matter in Des Moines. In tests to check up on efficiency of meters at small flows, 25 used meters of various makes which would not register at a rate under 1 gal. per minute, but otherwise accurate, were connected in series with a new and accurate meter of the same size and make. These pairs of meters were installed at various points on the system with the following results observed:

After 30 days of service—Old meters under-registered 8.8 per cent.

After 60 days of service—Old meters under-registered 8.8 per cent.

After 12 months of service—Old meters under-registered 12.5 per cent.

After 22 months of service—Old meters under-registered 11.2 per cent.

A retest of all 50 meters was made after the above service and from the results it was concluded that over registration of the new meters at the higher flows was the primary cause of the increasing difference between the registration of the old and new meters.

E. E. Bankson, Consulting Engineer, Pittsburgh, Pa. Chairman-Elect Finance and Accounting Division

H. H. Gerstein, Sanitary Engineer, Department of Public Works, Chicago, Who Did Much to Make the Convention Move Smoothly

The actual increase in registration which might be expected after repairing the old meters would amount to 8.5 per cent and therefore some inexpensive means of repairing meters to increase their accuracy at low flows should be of considerable interest to Water Departments.

Mr. Maffitt said that unaccounted for water in Des Moines had been decreased from 39 per cent to 30 per cent as the result of surveys and repairing meters to register low flows. He referred to the Ford "gulper" which is an attachment for ordinary meters for the purpose of causing them to measure accurately the very small flow ordinarily not registered. Experiments were under way looking toward improved methods of grinding in discs to fit the chamber more accurately. Use of an abrasive with water is preferable to the use of oil. They had had experience with a hard film being deposited within the meters—apparently by crenothrix which is an iron depositing bacteria which was somewhat beneficial in that it created a closer fitting of discs and more efficient registration at low flows. They had found grinding superior to cleaning with acid which removed the film.

The only weakness of meters in their present state of perfection is their lack of registration of small flows which may be an important part of the total water net registered in many cities.

Chicago's Water Works Activities

"Some Interesting Features of Chicago's Water Works Activities"—Myron B. Reynolds, City Engineer, Chicago, Ill.

Mr. Reynolds' paper, read by A. E. Gorman, called attention to the high rate of water consumption, amounting to 275 gals. per capita per day with maximum consumption peaks occurring at 7 a. m. and 7 p. m. in residential sections, at 2 p. m. in manufacturing districts and at 10 a. m. for railroads. Manu-

facturing minimum and maximum rates of demand had varied in the ratio of 1 to 1.45. In the best residential districts the per capita consumption had been between 1,000 and 2,000 gals. per capita per day.

Water surges in the tunnels supplying pumping stations had been a problem and piles used in construction had at times been accidentally driven through the walls of brick lined tunnels, creating a real danger. Mr. Reynolds called attention to the accretions of carbonate of lime which had formed within the tunnels—some projecting 12 inches into the conduit. He also commented on the economy of lowering the pressure on the mains in the residential districts at night by shutting down certain pumping stations after the heavy draught ceased.

A problem of consequence had been the rapid changes in chlorine demand of the lake water and that necessitated alertness of operators. Plans were under way to provide ammonia-chlorine treatment out at the cribs in the lake in order to simultaneously overcome the dangers of taste production and the hazard of under chlorination.

Mr. Reynolds' paper was discussed by **Chas. B. Burdick,** Consulting Engineer, of Chicago. Mr. Burdick stated that Chicago's chlorination difficulties came from trade wastes and domestic pollution from 180,000 people, which entered the south end of the lake via the Calumet River. The high water consumption in Chicago (275 gals. per capita) represented a sheer waste of 151 gals. per capita and 23 per cent of the consumption was unaccounted for. An interesting observation concerning water consumed in Chicago was that the tonnage of water pumped was about four times that of freight moving into the city each day.

"Locating and Eliminating Leakage in Chicago's Distribution System"—J. B. Eddy and **Bernard Phillips,** Water Pipe Extension Division, Bureau of Engineering, Chicago, Ill.

The paper, read by Mr. Phillips, set forth facts pertaining to leakage surveys, and stoppage of leaks since 1916 wherein 1,067 miles of distribution pipe had been covered. Resulting from the work, 24 m.g.d. leakage had been stopped on the 28.5 per cent of the system so far covered. The aquaphone is used extensively in the leakage surveys. The method of measuring leakage consists of isolation of two-block sections of the main by closing all services and shutting gate valves at the ends of the sections. A bypass around one of the gate valves, with a meter inserted, is used to measure the flow into the closed section and consequently represents the leakage out.

The authors described the system of maintaining numerous pressure recorders located at various points on the distribution system, and the value of such records was set forth. This system had made it possible to regulate pressures at night by controlled pumping and thereby reduce pumping costs materially.

F. B. Nelson, Assistant Engineer, Bureau of Water Supply, New York City, related experiences in leakage surveys and leakage reduction in New York City. The aquaphone had been used in locating and stopping 24 to 26 m.g.d. leakage.

"Ground Level Storage and Booster Station at Milwaukee, Wis."*—Herbert H. Brown, Engineer in Charge of Design and Construction of Pumping Stations, Milwaukee, Wis.

Mr. Brown told of the method employed in Milwaukee to correct conditions of low pressures in outlying districts during periods of peak consumption. The plan adopted is the construction of large steel storage tanks at ground level from which the water is automatically delivered by booster pumps back into the mains when pressures drop below a desired figure. When pressures exceed that required, the pumps kick out and water flows into storage from the mains until the next drop in pressure automatically brings the pumps into operation again, taking the water out of storage to maintain main pressure. One 6 million gallon covered tank had already been built and the booster station equipped with four 30 m.g.d. electrically driven centrifugal pumps is now under construction and another tank and booster station is already planned. The cost of the present project will be approximately $450,000—the tank being of electric welded steel construction.

Thomas H. Wiggin, of the Federal Water Service Corp., described a ground level storage tank of 6 million gallons' capacity which had been built by his company. The floor plates had been lap welded, but the wall plates were riveted. The tank was 24 ft. deep and 200 ft. in diameter.

"Twenty Years of Progress in Centrifugal Pumps"—A. Peterson, Chief Engineer, DeLaval Steam Turbine Co., Trenton, N. J.

Mr. Peterson reviewed the advances which had been made in designing centrifugal pumps within recent years. Notwithstanding the somewhat lower efficiency than the latest designed reciprocating pumps, centrifugal pumps are favored because of low first cost, carrying charges and small space they require. Centrifugal pumps were built now, up to 50 m.g.d. capacity with an efficiency of 90 per cent—something not attained in earlier designs.

R. D. Hall, Manager Worthington Pump & Machinery Corp., Harrison, N. J., in discussing Mr. Peterson's paper said that purchasers were expecting more of centrifugal pumps than they should. This because recent increases in flexibility of such pumps had fired imaginations.

Improved Cement for Mass Concrete

"Special Low Heating Cement for Mass Concrete Dams"—S. B. Morris, Chief Engineer Water Department, Pasadena, Calif.

In mass concrete dam construction the heat of chemical reaction during concrete hardening had come to be an important factor. To avoid such internal heating, and consequent expansion of the concrete, a cement having a heating value lower than normal cement had appeared desirable. Specifications had been drawn for supplying cements producing but 60 to 65 calories per gram (28 day test) for use in the Pine Canyon dam, whereas ordinary cement, compounded primarily to produce early strength, would produce 90 to 110 calories per gram. Three or four mills having the Pine Canyon contract for 470,000 barrels of the low-heating cement had been able to meet the specification. Mr. Morris thought that this perhaps was the first time that large orders for cement had been placed wherein a limit of heating had been specified, but he had found the better mills thoroughly able to meet it. He predicted that the future would see the development of new types of Portland cements to meet the requirements of particular uses.

Thaddeus Merriman, Chief Engineer of the New York Board of Water Supply, said that the studies made by Mr. Morris would probably start a new era in Portland cement specification and manufacture. He warned against too much weight being given laboratory tests because in practice mixing of sand and cement differs considerably from laboratory procedures.

*An illustrated article by Mr. Brown, describing Milwaukee's ground level storage project, appears on another page of this issue.—Editor.

COSTS AT FIVE SEWAGE TREATMENT PLANTS IN ILLINOIS

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IN comparison to the amount of data available on chemical processes, cost information is rare. Of the existing information in the literature, that on Imhoff tank plants predominates, due, doubtless, to the facts that there are fewer existing activated sludge plants, and that activated sludge costs vary so widely. These cost variations are largely effected by methods of sludge disposal and treatment, and by other differences in the methods of treatment. Since activated sludge is taking such a prominent place among sewage treatment processes, it is desirable that more cost information on the treatment be made available in order that comparisons with other treatment costs may be made.

In comparing the expenses of sewage treatment plants, it cannot be said that this plant is the more efficiently administered because it cost less to build and operate than that one. Many factors influence costs. Topography, land values, power rates, labor conditions, cost of materials, type of sewage, dilution available, and other things affect the choice of treatment process and expense of operation. Because of the fact that the same set of conditions does not prevail at any two of the plants discussed, direct comparisons of expense cannot be made, but some approximate conclusions can be drawn as to what to expect from similar works.

Descriptions of the Plants

Three of the plants discussed, those at Bloomington, Elgin, and Urbana, are of the Imhoff tank-sprinkling filter type, while another, at Decatur, has these units plus pre-aeration units used to relieve the load on the filters. The fifth plant, an activated sludge works at Springfield, Ill., has primary settling tanks, aerators, secondary settling tanks, and separate sludge digestion. Table I gives complete cost data on these plants. These data are for the fiscal periods ending in the years noted. In order to give more generally applicable conclusions, data from plants at Alliance,[1] Marion,[1] and Elyria,[2] Ohio; and Charlotte, N. C.,[3] were taken from the literature. Table II is the summarized information from all the plants studied. The treatment plants at Alliance and Marion are of the Imhoff tank-sprinkling filter type, while the rest are activated sludge plants.

In selecting the above plants for discussion, treatment works serving population of from 20,000 to 70,000 were chosen. It is not believed that the results indicated by this study will be applicable directly to plants serving less than 20,000 or more than 70,000 persons.

The treatment plant at Springfield was not finished at the time the data were secured. It provided complete treatment for about 40 per cent of the sewage flow; the rest of the sewage received simply sedimentation. This condition does not substantially affect the operating costs, but it makes the unit construction cost appear higher than it should.

TABLE I.—COST DATA FOR SEVERAL SANITARY DISTRICTS IN ILLINOIS.

Plant and Population	Average Daily Flow M.G.D.	Tax Levy	Bond Interest and Retirement	Extensions and Betterments	Overhead Expense	Operation and Maintenance Power	Operation and Maintenance Total	Total Annual Expense
Bloomington and Normal (38,600)—								
1928	...	$88,660	($69,375)	.....	....	.....	.....	.....
1929	5.29	108,586	(67,525)	.....	....	.....	.....	.....
1930	4.87	88,800	65,675	$12,001	$3,035	$5,642	$20,642	$101,353
1931	...	.....	63,825	4,636	3,182	3,834	19,834	91,471
Average	5.08	95,349	64,750	8,318	3,108	4,738	20,238	96,412
Decatur (57,500)—								
1928	10.43	118,890	72,825	200,391	3,802	5,752	40,353	317,371
1929	11.54	137,771	70,650	2,159	3,293	16,894	43,108	119,210
1930	10.45	128,000	68,475	20,428	6,132	16,629	40,073	135,108
1931	...	.....	66,300	14,814	5,603	16,928	42,173	128,890
Average	10.81	128,220	69,562	59,448	4,707	14,051	41,426	175,145
Elgin (35,000)—								
1928	3.40	105,959	(56,500)	.....	....	.....	.....	.....
1929	4.18	106,332	57,050	3,496	1,351	7,858	21,344	83,241
1930	3.94	108,094	55,750	8,763	1,284	8,194	27,062	92,859
1931	...	.....	56,400	23,411	1,356	7,757	24,894	106,055
Average	3.84	106,795	56,400	11,890	1,330	8,136	24,431	94,058
Springfield (71,900)—								
1928	...	239,990	(87,050)	.....	....	.....	.....	.....
1929	...	239,952	(131,475)	.....	....	.....	.....	.....
1930	7.5	251,780	131,505	31,438	10,178	6,715	27,628	200,479
1931	...	.....	131,400	54,110	9,831	7,565	27,244	222,585
Average	7.5*	243,907	131,452	42,774	10,004	7,140	27,436	211,532
Urbana-Champaign (41,800)—								
1928	3.63	79,935	34,050	4,438	2,600	3,356	18,404	59,492
1929	3.76	70,810	35,510	3,238	3,392	4,269	16,993	59,133
1930	2.92	70,550	36,880	34,155	4,057	5,048	20,174	95,266
1931	...	.....	38,160	.....	6,195	4,269	20,271	64,626
Average	3.44	73,765	36,150	10,457	4,061	4,235	18,961	69,629

*Indicates total flow to treatment works. Complete treatment given to about 40% of this flow. Figures in parentheses not included in averages.

TABLE II.—DATA ON SEWAGE TREATMENT EXPENSE.

Plant	Original cost construction	Computed bond expense	Annual operating expense	Total annual expense	Capacity persons (thous.)	Designed capacity (M.G.D.)	Population served	Actual flow (M.G.D.)
Imhoff Tank-Trickling Filter—								
1. Bloomington	$596,310	$47,710	$20,240	$67,950	54.0	6.75	38.6	5.08
2. Decatur (I)	722,810	57,825	22,180[e]	80,005	60.0	7.96	43.0	11.0
3. Decatur (II)	963,190	77,055	41,426	118,481	150.0	10.0	57.5	10.81
4. Elgin	435,210	34,814	24,430	59,245	37.5	3.31	35.0	3.84
5. Urbana	504,335	40,345	18,960	59,305	45.0	1.96	41.8	3.44
6. Alliance,[1] Ohio	490,000	39,200	17,250	56,450	36.0	3.6†	20.0	2.2
7. Marion,[1] Ohio	539,200	43,125	19,000	62,125	40.0	4.0	24.0	1.4
Activated Sludge—								
1. Springfield, Ill.*	355,000	28,400	27,436	55,836	30.0	3.75	71.9	2.7
2. Charlotte,[3] N. C.	310,000	24,800	29,434	54,234	...	6.0	41.0†	3.0
3. Elyria,[2] Ohio	394,000	29,520	24,000	53,520	36.0	3.6	21.0	2.0

(I) Prior to 1927.
(II) Since 1927, Imhoff tanks, trickling filters and pre-aeration.
†Estimated.
*Gives complete treatment to about 35% of influent.

Trend of Construction Costs

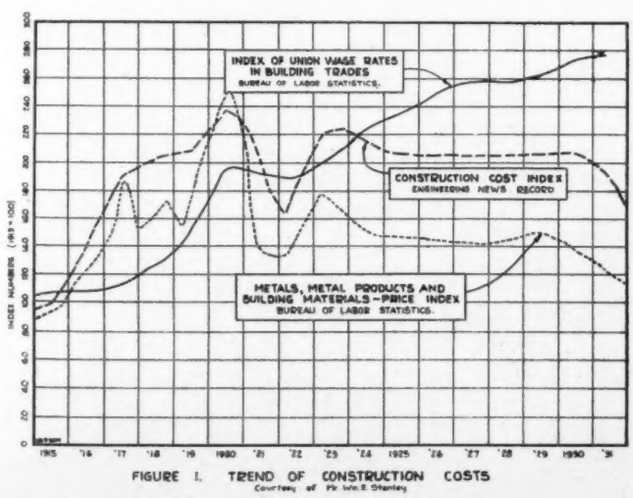
The approximate trend of construction costs since 1915 is shown in Figure 1. In this illustration, minor variations were omitted as it is intended to show only the general flatness of the "Construction Cost Index" curve from 1922 to 1930. There were some deviations, but these were minor, amounting to 10 per cent or less. Since local conditions appear to affect costs to a larger degree than this, it did not seem necessary to correct for current construction costs at the time of construction. The plants discussed were built between the years 1922 and 1930.

Division of Data

The cost data have been sub-divided into four groups: (a) Bond Interest and Retirement, (b) Construction Costs for Extensions and Betterments, (c) Overhead Expense (including legal and engineering as well as general administration expense and depreciation) and (d) Operation and Maintenance Expense. The data exclude, as well as possible, all cost for interceptor construction, operation and maintenance, although some interceptor maintenance and power expenses are included in the Operation and Maintenance costs. The original construction costs of the treatment works are for the treatment plants alone.

Bond Interest and Retirement

It is extremely difficult to get information on the annual bond interest and retirement expense for any sewage treatment plant. Generally, when a plant is built, a bond issue is floated which pays for the cost of the whole sewage disposal project, including treatment plant, intercepting sewers, and pumping stations. The bond data in Table I are for the whole treatment project. To arrive at more comparable figures, the bond expense for each plant was computed as though all the plants were built at the same time.


INDEX OF UNION WAGE RATES IN BUILDING TRADES
BUREAU OF LABOR STATISTICS.
CONSTRUCTION COST INDEX
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BUREAU OF LABOR STATISTICS.
INDEX NUMBERS (1913=100)
1915 '16 '17 '18 '19 1920 '21 '22 '23 '24 1925 '26 '27 '28 '29 1930 '31

FIGURE 1. TREND OF CONSTRUCTION COSTS
Courtesy of Mr. John E. Stanley

In computing bond expense, it was assumed that 20-year bonds, bearing 6 per cent interest, would be issued. Probably 6 per cent is a higher interest rate than is paid by most sanitary districts or similar organizations for long term loans. It was assumed, also, that the retirements would be made in 20 equal annual instalments. This causes the bond interest and retirement expense to range from a maximum at the end of the first year to a minimum at the end of the last year. The figures given are based upon the principal and interest payments at the end of the eleventh year, at which time half of the capital has been paid off and the total annual expense amounts to 5 per cent of the original investment for retirements, plus 3 per cent for interest. This gives a figure of 8 per cent of the original construction costs for annual bond interest and retirement. The bond retirement scale could be so arranged that the total bond interest and retirement each year would be constant. However, the method used gives an approximation of this figure.

Extensions and Betterments

Under the items for Extensions and Betterments are included costs of works built after completion of the original plant. Where major construction work, such as the building of additional units to increase capacity, was done after the original plant construction, the expense was taken out of Extensions and Betterments and entered under the original construction cost. This was done in the case of Decatur where the pre-aeration plant was added to the original layout, and at Urbana where a secondary settling tank was installed several years after the completion of the rest of the plant. All minor extension and betterment expenses were disregarded as they vary at different times and places and are next to impossible to predict.

The cost data for Decatur are divided into two classes: those given under "Decatur I" are for the Imhoff tank-sprinkling filter plant prior to 1927; the data under "Decatur II" are given as the cost of the original plant plus the cost of the pre-aeration equipment. The computed bond expense is based on this figure and on the same assumptions as were made in computing this expense at the other plants.

Overhead Expense

From Table I, it may be seen that the overhead expense for several sanitary districts in Illinois amounts to about 5 per cent of the total annual expense. Checking this figure against information from several other cities,

it was seen that 5 per cent was a conservatively average figure. Hence, it was made to include depreciation as well as administration expense. Administration expense includes the regular annual retainer fees of engineers and legal advisors and the salaries of the trustees and administrative officers of the district.

Keefer,[4] in setting forth his costs at Baltimore, Md., assumed a composite life of 33⅓ years for his plant. In this study, the composite lives of the plants were assumed to be 30 years. Government bonds may be purchased which bear 4 per cent interest. If a sinking fund is set up to which annual contributions of approximately 1.283 per cent of the original construction costs are made, at the end of 30 years a sum equal to the original construction cost of the plant will have accumulated. As was stated above, this small percentage has been included in the 5 per cent figure for overhead or administration expense.

Operation and Maintenance

Under the heading "Operation and Maintenance" are included such items as: power, wages for superintendence and labor, repairs, supplies, new equipment, laboratory and office expense, and coal and water. Other items which are connected directly with operation and maintenance, such as the purchase of a scum-pump, would be credited to this account. It would be difficult to draw a line between new construction and operation and maintenance but this is not essential, for however entered on the books, the total remains the same.

There is considerable variation from plant to plant in the amount of sewage pumped and the cost of power for pumping. These two factors cause differences in the operation costs of the plants. From Table III, which shows the power costs and their relation to operation costs, it is seen that they vary between 20 and 35 per cent for the plants listed. From this one might expect that power costs would seldom reach one half of the total operation expense. Consequently, for rough estimates of the total costs of treatment, variations in pumping conditions are not of great influence.

The two largest items in operating costs are power, and labor and superintendence. Together these two form more than 65 per cent of the total in the plants for which data were available. These figures also are given in Table III. The remaining items: repairs, supplies and new equipment, laboratory and office expense, and coal and water are rather minor factors and do not materially affect the total operation costs.

Appreciable savings can be made on labor costs by careful planning of the treatment work. One operator studied over the work necessary at his plant during the year and laid out a program for the operation of the plant, alloting each job a certain date. Sludge drawing and removal, plant repairs and grounds maintenance, and other work to be done, were distributed evenly over the year. He then hired a small group of men who worked through the year, and in this way, he eliminated the occasional hiring of extra help at higher pay. In other words, the operator spread his work over the year, cutting off a peak here and putting it in a spot where otherwise there would not be any necessary work to do.

Another operator employed a scheme involving a similar principle. He was finding his power bills far above what they should be. An investigation showed that he was paying a higher demand charge than that called for by the sewage pumpage. The trouble was located in the laboratory which was electrically equipped throughout. The chemist was running his analyses at the time of peak daily flow; and his electrical distillers, evaporators, furnaces, incubator, refrigerator, and other apparatus, all running at the same time, were boosting the demand "sky-high." By planning out the laboratory work so that distilling and similar operations were done at night, a large reduction in power expense was effected.

Sewage Treatment Plant at Elgin, Ill., Showing Office and Laboratory Building at Right, Imhoff Tanks in Center, Sludge Drying Beds Left Foreground, and Dosing Tanks and Filters in Left Background.
Sewage Treatment Works of Springfield, Ill.

Costs at Elgin are raised by the large amount of pumping. There it is necessary to repump sewage at several points. Power costs are increased at Bloomington, too, by the lifting of the sewage against a 40 foot head.

Table III also shows the unit power costs which vary between one cent and 2½ cents. This cost further influences operation expense. It is one of the deciding factors in choosing the type of treatment. The low unit cost at Springfield was probably one reason for choosing the activated-sludge process. The power cost there speaks well for the municipal ownership of the system, for even with this low rate the company shows a profit.

At Springfield and Elyria the power costs for treatment alone were $7.24 and $12.33 per M.G. treated respectively. It will be possible to reduce this expense

TABLE III.—OPERATION COSTS.

City	Total Operation Cost	—Power Expense— per Kw.H.	per year	% of total	Labor, Superintendence per year	% of total	Misc. % of total
Bloomington	$20,238	2.172c	$4,738	23.4	$12,500	61.8	14.8
Decatur	41,426	1.403	14,051	33.9	16,620	40.1	26.0
Elgin	24,431	1.76	8,136	33.4	13,202	54.1	12.5
Urbana	18,961	2.29	4,235	22.4	8,135	41.9	35.7
Springfield	27,436	1.05	7,140	26.1	13,327	48.5	25.4
Elyria	24,000	....	9,000	37.5	.....	....	....
Charlotte	29,208	1.515	16,368	56.0	10,800	37.0	7.0

TABLE IV.—ANNUAL SEWAGE TREATMENT COSTS.
(On the bases of populations served and flows treated.)

Plant	Construction Costs per M.G.D. capacity	Construction Costs per capita capacity	Operating Costs per M.G. treated	Operating Costs per capita	Computed Bond Expense per M.G. treated	Computed Bond Expense per capita	Total Expense Plus 5% for administration per M.G treated	Total Expense Plus 5% for administration per capita
Imhoff Tank-Trickling Filter—								
Bloomington	$ 88,340	$11.03	$10.86	$0.528	$25.60	$1.668	$38.28	$2.305
Decatur (I)	90,890	12.03	5.15	0.517	14.40	1.343	20.52	1.953
Decatur (II)	96,319	6.42*	10.47	0.720	19.50	1.343	31.96	2.166
Elgin	131,483	11.60	17.42	0.698	24.80	0.995	44.33	1.777
Urbana	249,880	11.20	15.03	0.453	32.00	0.965	49.38	1.489
Alliance	134,800	13.61	21.60	0.862	84.50	1.797	111.40	2.792
Marion	136,110	13.48	37.20	0.792	49.00	1.960	90.51	2.889
Activated Sludge—								
Springfield	94,670	11.83	27.70	1.061	28.70	1.098	59.22	2.267
Charlotte	51,670	....	26.70	0.718	22.50	0.605	51.66	1.389
Elyria	109,440	10.94	32.90	1.142	43.20	1.501	79.90	2.775

*Based on population-equivalent capacity.

at Springfield when the plant is completed as the blowers in use now are of greater minimum capacity than is thought necessary to give satisfactory treatment. The quantity of air per gallon of sewage treated will be reduced to some extent with complete treatment. Possibly the same condition exists at Elyria where the flow is slightly more than one half the designed capacity.

Actual Unit Costs

Table IV shows the costs based on flows treated and populations served. One fact is shown strikingly in this table, to wit.—the plants furthest from their capacities display the highest unit treatment costs. The plants at Bloomington, Alliance, and Marion, where design capacities considerably exceed present conditions, show high unit expenses. The costs at Elgin are elevated by power expense and overloading.

The data on actual costs differ so widely, because of the difference between future capacities and actual present conditions, that any comparison of actual costs would have little value. In order to make a better comparison some other basis should be used.

Costs on a Design Capacity Basis

Cost data may be based on design capacities without introducing much error. Regardless of the age of the plant, the sum of the bond expense and the overhead remains quite constant. The only variables are extensions and betterments, and operation cost. For this study extension and betterment expenses are disregarded. The annual operation expense is at its minimum when the plant is built and increases to a maximum at the time when maximum average flow is reached—that is, when the capacity of the plant is reached. It can be seen after a study of the data in Table III that the labor and superintendence, and the power expenses form the greater part of operation cost. Labor may increase as the plant nears capacity, but it will not be a large increase. Superintendence remains constant. Power costs certainly increase, but not in a direct proportion to the flow. Due to the arrangements usually made for purchase of power, the more power used, the cheaper the unit cost. From this it appears that, while operation costs are bound to increase to some degree as the plant reaches its capacity, the cost increase will not be nearly in direct proportion to the flow increase. Since other expenses are independent of the sewage flow, the capacity basis for comparisons is satisfactory. Table V gives costs based on present annual expenses and future plant capacities. In view of the present day lower costs, it is believed that the figures arrived at will not be much below future unit costs.

The $87.00 figure for the upper limit of per M.G. costs for Imhoff plants is higher than normal. This figure, obtained from Urbana data, is based on treatment of entirely domestic sewage. The plant, designed for a flow of 1.96 M.G.D., receives nearly twice that, so the

Sprinkling Filters, Dosing Tanks and Sludges Drying Beds at Bloomington, Ill.

$87.00 figure might be replaced with $51.50 as the upper limit. The $0.83 figure from Decatur is low since it is based on population-equivalent. A more representative figure would be $1.30. These data would

TABLE V.—COST DATA ON TREATMENT WORKS (based on design capacities).

Plant	Construction Costs per M.G.D.	Construction Costs per capita	Annual Operation Costs per M.G.	Annual Operation Costs per capita	Total Annual Expense Plus 5% Administration per M.G.	Total Annual Expense Plus 5% Administration per capita
Imhoff Tank-Trickling Filter—						
Bloomington	$ 88,340	$11.03	$ 8.08	$0.375	$28.20	$1.320
Decatur (I)	90,890	12.03	7.63	0.370	28.90	1.400
Decatur (II)	96,319	6.42	11.34	0.276	34.10	0.830
Elgin	131,483	11.60	20.19	0.653	51.50	1.659
Urbana	249,880	11.20	26.52	0.422	87.00	1.384
Alliance	134,800	13.61	7.56	0.479	45.20	1.647
Marion	136,110	13.48	22.74	0.475	44.70	1.630
Activated Sludge—						
Springfield	94,670	11.83	19.94	0.914	42.80	1.953
Charlotte	51,670	.....	13.35	.....	26.00	.....
Elyria	109,440	10.94	18.46	0.667	42.80	1.561

The total annual expense figures range as follows:

Type of plant	Per M.G. from	Per M.G. to	Per Capita from	Per Capita to
Imhoff tank-sprinkling filter	$28.00	$87.00	$0.83	$1.70
Activated sludge	26.00	43.00	1.50	2.00

indicate a slight advantage for activated sludge when costs per M.G. are reckoned, but when per capita annual expense is considered, the tank-filter treatment has the lead.

Construction costs per unit capacity were found to be very uniform with the exceptions of Urbana and Decatur. Disregarding the cost per M.G.D. capacity at Urbana, construction costs ranged from $88,000 to $136,000 per M.G.D. for tank-filter plants, and from $50,000 to $109,000 for activated sludge works. Omitting the population-equivalent figure for Decatur, per capita capacity construction costs ranged from $11.00 to $13.50 for tank-filter plants and from $10.90 to $11.80 for the activated sludge works.

It is believed that these figures may be used for approximating treatment costs in other plants by basing costs of the plants on designed capacities. One possible usage is in estimating roughly costs for design and promotion purposes. In order to arrive at the actual cost, the estimator would have to modify the above data by approximating the growth of the district served and the increase in sewage flow and thereafter convert the data to an actual per capita basis. It will be necessary also to make allowances for special conditions at the place being studied, such as for strong industrial wastes or strictly domestic sewage.

Wide differences in conditions prevent anything but very general conclusions.

By careful planning of the work, the superintendent can save money in operating his plant.

The data given are for plants serving populations of from 20,000 to 70,000 and may not be strictly applicable to works outside this range.

The writer is indebted to Mr. J. J. Woltman of Bloomington, Dr. W. D. Hatfield of Decatur, Mr. E. E. Smith of Elgin, Mr. G. H. Radebaugh of Urbana, and to Mr. H. F. Ferguson of Springfield for the data on costs of treatment works in Illinois, and to the others whose writings were referred to above.

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J. R. McWane

James R. McWane, president of the McWane Cast Iron Pipe Company at Birmingham, Ala., and of the Pacific States Cast Iron Pipe Company at Provo, Utah, died, following a heart attack, while in Chicago on June 24th. He leaves a widow and one son who is secretary of the McWane Company.

Mr. McWane had gone to Chicago to attend the convention of the American Water Works Association and was accompanied by J. D. Sample, vice-president, and pany. Mr. McWane was born in Wytheville, Va., on Aug. 15, 1869, prepared himself to become a minister of the gospel and followed this calling after graduating from Bethany College (W. Va.) at the age of twenty-two. He was called from his pulpit to help his father untagle some knotty business problem and, in consequence, decided to give up preaching and enter business with his father.

He became general manager of the McWane Plow Works at Wytheville, Va., and later became president of the Lynchburg (Va.) Plow Company in 1896. He resigned in 1903 and, shortly after, went to Birmingham where, in 1907, he went with the American Cast Iron Pipe Company. "Golden Rule" J. J. Eagan was president of that company at the time and gave McWane free hand in production which he succeeded in stepping up 300 per cent. In consequence, he was later made president of that company.

In 1922 he left the American Cast Iron Pipe Company. And, being determined to work out a pet idea of his, he started the McWane Cast Iron Pipe Company. McWane's patented idea of casting pipe horizontally instead of vertically (which the use of green sand, instead of dry sand, for making the molds and cores made possible) proved practical and offered advantages in manipulation and certain improvements in quality of the product. He was also the pioneer producer of pre-caulked small diameter C. I. pipe which is used for water service connections, in filtration plants, sewage treatment works and industrial plants. Following his success at Birmingham he organized the Pacific Coast C. I. Pipe Co. and built a modernized plant at Provo, Utah.

Interestingly enough, the earliest method of making cast-pipe was that of horizontal pouring and it was by a queer turn of fate that an "Engineer of the Lord" left his charge and revived this method of manufacture (with improvements), to see built up an important unit of the pipe industry, with a production of 90,000 tons per year, before he laid aside his work for all time.

WATER PURIFICATION AT THE CHICAGO CONVENTION OF THE AMERICAN WATER WORKS ASSOCIATION

By JOHN R. BAYLIS, Associate Editor
Physical Chemist, Bureau of Engineering, Chicago, Ill.

THE Water Purification Division of the American Water Works Association had its usual number of interesting papers on water treatment and filtration at the Chicago convention of the Association. The attendance, or at least the registration, was not up to that of some of the previous conventions, yet the water purification sessions were well attended. A number of those attending who could ill afford the registration fee did not register.

Geo. D. Norcom

A delightful part of the program was the Annual Dinner of the Water Purification Division on Tuesday. "Bill" Orchard provided the entertainment, and he was ably assisted by Paul Hansen, Dr. Floyd Mohlman and others. Leave it to "Bill" and you are assured of plenty of amusement.

Officers elected for the ensuing year are:

Chairman.....George D. Norcom
Vice Chairman.....Sheppard T. Powell
Secretary.....Harry E. Jordan
Executive Committee .....
Joseph W. Ellms, Arthur E. Gorman, Charles R. Cox

Papers and Discussions

Current Research in Water Bacteriology. JOHN. F. NORTON, The Upjohn Co., Kalamazoo, Mich.

The high percentage of nonconfirming organisms which give a presumptive test for B. Coli causes considerable work in some of the water works laboratories. Considerable work has been conducted on inhibiting agents within recent years. Bile, medium, which was used to a certain extent years ago, has been revived. There is very good correlation between the number of organisms of the colon-aerogenes group determined with brilliant green bile and eosin methylene blue agar. Direct plating methods for determining members of the colon-aerogenes group have advantages over broth tubes, but it is difficult, without considerable experience, to make distinction between some of the groups by direct plating methods. Investigations by Ruchoft on mixed cultures explains some of the difficulties in getting consistent results. Inhibiting media should be used with precaution, and direct plating methods have not been developed to a practical procedure.

N. J. HOWARD mentioned the differences produced by various bile salts found on the market, and recommended that some standard for the salt be adopted. This recommendation also applied to dyes used in culture media. The Dominick-Lauter medium was not of much value until the proper quality of dye was used. Pure or cultivated cultures do not give as satisfactory results as tests made directly upon the water.

C. J. LAUTER stated that more adverse results were obtained with pure cultures than cultures from water.

Report of Committee on Testing Water Purification Materials. M. M. BRAIDECH (Chairman), Baldwin Filters, Cleveland, O.

This committee, which was organized in December, 1932, presented a very lengthy report. Twenty-seven different chemicals were found to be used to a greater or lesser extent in water treatment. The committee plans to prepare a complete monograph covering each chemical, giving the methods of manufacture and uses of the materials. The procedure contemplated for obtaining data for the monographs was outlined and tentative specifications for a number of water works chemicals already have been prepared.

R. C. BARDWELL commented that this was the most extensive piece of work ever put out by a committee of the Division.

Determining the Quality of Zeolites. HOWARD L. TIGER, The Permutit Co., New York City.

Mr. Tiger presented a very extensive discussion on determining the qualities of zeolites. There are three general types of zeolites and over twenty distinct products which fall within these groups. The main groups are glauconite, precipitated synthetic, and fused synthetic. The glauconites are produced chiefly from the marl deposits (greensand) of New Jersey. The precipitated synthetic zeolites are made from sodium silicate, sodium aluminate, and alum; and the fused synthetic zeolites are made by fusing soda-ash, kaolin and feldspar in a furnace. The exchange value of the glauconites is about 2,700 to 3,800 grains of $CaCO_3$ per cubic foot when using 1.4 pounds of salt per cubic foot, the exchange value of the precipitated synthetic materials varies from 6,000 to 20,000 grains for each 4 to 8 pounds of salt, and the exchange value of the fused synthetic materials varies from 4,000 to 8,000 grains requiring about 4 pounds of salt. Where the volume of the zeolite is small and ruggedness and long life are not so important, such as is true of household units, precipitated synthetic zeolite may be used to advantage. Glauconite is preferred in most industrial installations where the water is aggressive to zeolites, and where the material serves as a filter where dealing with small amounts of turbidity. Turbidity is undesirable, however, and may stop up the pores in zeolites. The physical and chemical characteristics of zeolites, such as appearance, feel, screen analysis, weight per unit volume, porosity, resistance to abrasion, chemical composition, resistance to aggressive attack, and exchange value, were discussed. Development of testing methods for determining these various factors was discussed in considerable detail. There is great need for an accelerated test for revealing durability.

A. S. BEHRMAN, of the International Filter Co., stated that most of the pores in zeolites are too small to be stopped up by particles usually found in turbid waters.

Proposed Plan for Ammonia-Chlorine Treatment at Chicago. A. E. GORMAN and H. H. GERSTEIN, Bureau of Engineering, Chicago, Ill.

There has been a gradual increase in the bacterial content of Lake Michigan water at the Dunne Crib, which supplies the water to a large portion of the inhabitants on the south side of the city. Pollution has reached the point where an increase in chlorine over the amount used at the present time will result in objectionable chlorinous tastes. It is expected that pollution will increase when diversion of lake water is further limited. At the present time it is difficult to maintain residual chlorine in the water to the outlying points on the distribution system, and at times there is considerable increase in the bacterial content of the water where residual chlorine is not maintained. It is planned to install an ammonia and chlorine plant at the Dunne Crib, and change the point of applying the chlorine from the pumping stations to the crib. The pumping station chlorinating plants will be kept ready, however, to be thrown into use within a few minutes in case enough chlorine is not added at the crib. The minimum time of travel of the water from the crib to the 68th Street pumping station, the nearest station to the crib, is about 1.5 hours. The ammonia will be introduced into the water near the surface of the water in the crib and the chlorine will be introduced at the bottom of the shaft where the water enters the tunnel. This will give sufficient time for the ammonia to become thoroughly mixed with the water before the chlorine is added. Ammonium sulfate probably will be used. The chlorine will be shipped in one-ton cylinders and the cylnders will be submerged in a warm water bath when in use. The application of the ammonia and chlorine will be controlled by tests made at the 68th Street pumping station. The pumping rates at the pumping stations located on the system will be telephoned to the testing station, and the amount of ammonia and chlorine to be used will be telephoned at frequent intervals to the operator at the crib.

L. H. ENSLOW said that the city was going to the limit in giving protection with chlorine, that aftergrowths may come from the deposits in the pipes, and that because of the fusible sludge melting at 167° F. there was some hazard in heating chlorine cylinders.

M. C. SMITH stated that introduction of the ammonia-chlorine treatment at Richmond, Va., eliminated complaints throughout the distribution system and reduced corrosion.

M. M. BRAIDECH said there was a chlor-organic taste in the Cleveland water for a short time last fall that appeared to be caused from the addition of ammonia to the water.

Report of Committee on Control of Tastes and Odors. MARTIN J. FLENTJE (Chairman), Community Water Service Co., New York City.

The committee attempted to collect data on tastes and odors over the entire United States. Reasonably complete data on taste elimination methods were obtained from twelve states. There was a large increase in the number of cities using the ammonia-chlorine treatment, but this cannot be attributed entirely to taste elimination, for much of the use of this treatment is for improving sterilization. Activated carbon appeared to be the most widely used treatment for the removal of tastes and odors. Bleaching clays, potassium permanganate, superchlorination, and ozone are not used to any extent in municipal supplies in the United States. Reports from 332 plants showed that 35 per cent were using ammonia-chlorine and 34 per cent activated carbon.

FRED E. STUART said the outstanding development in odor elimination was improvements in the methods of odor determination. Most of the plants now using activated carbon apply the carbon to the water in the mixing basin. When odor is first detected in the water a very good procedure is to seed the filter beds with carbon and simultaneously start the application of carbon at the beginning of the treatment process. Application of the carbon to the filters could usualy be discontinued after the treatment applied at the beginning of the process reaches the filters.

The Removal of Aggressive Carbon Dioxide by Contact Beds of Limestone. CHARLES R. COX, State Dept. of Health, Albany, N. Y.

Prevention of corrosion by the addition of lime to water is now well established. It is difficult to control the application of lime to small water supplies, and under such conditions it may be best to use contact beds of limestone. Aeration may be used to reduce the CO_2 but it seldom reduces it to less than 3 to 5 p.p.m., consequently aeration alone cannot always be relied upon for corrosion prevention. Passing water containing 20 p.p.m. of carbon dioxide through 24 inches of limestone reduced the CO_2 to 1 p.p.m. Running water containing alkalinity of 10 parts and CO_2 of 26 parts through a bed of one-half to three-quarter inch size limestone with a contact of about 30 minutes reduced the CO_2 to 3.0 and increased the alkalinity to 50 p.p.m. The limestone beds at Frankfurt, Germany, reduces the CO_2 from 30 to 3 p.p.m., and increases the pH to 7.0. About 600 pounds of marble are dissolved per million gallons of water. A contact time of 20 minutes should be provided where the CO_2 is about 30 p.p.m. Soft limestone and marble seem to be better than the harder materials. Limestone costs from $1.00 to $1.50 per ton at the quarry.

MALCOLM PIRNIE referred to the coarse material of filter beds composed of limestone being dissolved by the water.

Disposal of Lime Sludge at Water Softening Plants. W. H. DITTOE, Mahoning Valley Sanitary District, Youngstown, O.

The disposal of sludge from a softening plant using lime, or lime and soda, is becoming a very serious problem at many of the plants. Provision for disposing of the sludge from the new water purification and softening plant at Youngstown, Ohio, was described. The water is treated with lime, soda, alum and CO_2. Dorr type sludge removers are used. Lime recovery was considered but had not seemed practical. The plan adopted was sedimentation in ponds. Three ponds were constructed, each of which was estimated to hold the sludge produced in one year. It is planned to fill one pond at a time, divert to the second pond, and then to the third. After one of the ponds is filled, it will be allowed to dry out and the sludge is to be removed and used for filling low land or disposed of to the farmers for applying to the soil. The sludge will settle to 70 per cent water very quickly, and it was estimated that it would concentrate to about 60 per cent in the ponds. The cost of the ponds was approximately $9,500. The first pond has been in use 10 months, and with 10 million gallons of water being treated daily at the plant it was now 59 per cent full. A sample of the sludge had a moisture content of about 60 per cent.

T. R. LATHROP referred to several places where disposal of the sludge from water softening plants caused trouble. The sludge may be used for filling low ground.

The **Committee on Filtering Materials** issued a brief progress report. The writer in discussing the report called attention to some of the obstacles which will be encountered in attempting to compute filter performance by mathematical equations.

Control of Manganese and Iron Accumulation in Filter Sand. P. W. Frisk, American Enka Corp., Enka, N. C.

Mr. Frisk discussed the purification of water high in content of iron and manganese, the pre-treatment productive of oxidation and the effect of accumulation of such materials in filter beds. The most effective pre-treatment of the raw-water had involved use of chlorine alone or, better yet, chlorine in combination with permanganate. Manganese from the Enka water could be allowed to accumulate in the filter bed to the extent of 1 per cent by dry weight of the sand without creating difficulties. Experimental work involving clean new sand, sand coated with iron and manganese and the latter after treatment with caustic soda had indicated the value of caustic soda treatment (10 per cent solution for 6 to 12 hour contact) to loosen film on sand grains which could then be removed by the wash water. The plant filters washed periodically with the "air rake" had not accumulated more than 0.5 per cent of manganese and iron within the sand (dry basis) after 5 years of operation—most of the manganese having been precipitated in the basins. Coagulation of the oxidized water had involved use of alum and soda ash.

Fundamental Factors Governing the Flow of Water Through Sand. Gordon M. Fair, Harvard University, Cambridge, Mass.

The author presented a rational derivation of a formula for the flow of water through sand beds. In the derivation, the bed is treated as an actual unit, instead of as a group of ideally arranged spheres. To do this, use is made of the hydraulic radius, which, for a sand bed, was assumed to be equal to a constant times the volume of water divided by the surface area of the sand. This hydraulic radius depends upon sand sizes present, porosity, and the shape of the sand. A shape factor, which accounts for variations in the surface area of the sand grains is used. Sand size is determined by sieving and each of the sieved separations is taken into consideration so that the hydraulic radius is that of the whole bed. Porosity is measured in the bed. Use is made of the Reynolds number to prove the correctness of the formulation. It is shown that:

1. Loss of head depends upon kinematic viscosity.
2. Loss of head varies directly with the depth of bed.
3. Loss of head varies inversely with sand size squared.
4. Loss of head varies as $\frac{(1-P)^2}{P^3}$ where P is the porosity or per cent voids.
5. Loss of head varies directly with the velocity.
6. Loss of head depends upon shape of sand grains.

The derivation gives a general conception of the flow of fluids through porous materials, which has a wide range of application. From it may be computed: initial loss of head through slow sand filters, rapid sand filters, and the loss of head through rapid sand filters being washed. It can be applied to the flow of gases through packed tubes, and to the flow of water through ground.

H. E. Hudson stated that the Chicago experiments in general corroborated the results of Prof. Fair. He suggested standardization of the sieving procedure at each laboratory to assure consistent results, and also suggested the use of round sand for sieve calibration. Chicago data on actual operation of filters show that the clogging rate (rate of increase of loss of head) varies with sand size in the same way that initial loss of head varies with sand size.

Committee on Boiler Feed Water Studies. Sheppard T. Powell, Chairman. C. R. Knowles presided in the absence of the chairman. The discussions were confined largely to remarks about the use of boiler compounds and boiler water treatment. As a result of treating the water, boiler corrosion on railroad locomotives has been greatly reduced and flue renewals are now much less frequent on some of the railroads.

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Cost of Sewage Treatment at Schenectady

The 18th Annual Report of the Schenectady Bureau of Sewers, prepared by Morris M. Cohn, Superintendent of the Bureau, contains the following comments on operating costs for the sewage treatment plant, and pumping station during 1932.

During the year stringent operating economies resulted in a net saving of $7,000—$23,000 being expended on treatment plant operation and maintenance and $11,000 on pumping station operation, making the total $34,000 which represents the minimum expenditure of the past decade.

An average of 8.41 m.g.d. sewage per day passed through the treatment plant.

The following table gives the itemized account of costs:

Cost of treatment	$ 7.47 per m.g. treated
*Cost of pumping	3.58 per m.g. treated
Total cost	11.05 per m.g. treated

Itemized Cost of Treatment

Labor	4.74 per m.g. treated
Supervision and control	0.89
Light and power	0.44
Repairs	0.18
Supplies	0.17
Replacement and purchase	0.11
Taxes	0.82
Miscellaneous	0.12

Itemized Labor Costs

Control	0.15 per million gals.
Bar rack and screenings	0.14
Imhoff tanks	1.56
Trickling filters	0.24
Sludge beds	0.90
Night operation and cleaning	0.94
Maintenance and repairs	0.81
Total	$ 4.74

*$0.1078 per m.g. pumped per foot of head, against total head of 22 feet.

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North Carolina Holds Water Plant Operator's School and Conference

The first North Carolina School and Conference for Filtration Plant Operators was held June 28th and 29th at State College in Raleigh, N. C. In the conference and school, sponsored by the State Health Department, such matters as the following were discussed. (1) Construction, operation and care of pumps and motors; (2) Methods of water analysis (demonstrations); (3) Mixing and coagulation in theory and practice; (4) Measures used in taste and odor correction or prevention; (5) Points for protecting iron equipment, tanks and standpipes; (6) Washington settling basins. A symposium was held on the biology of raw water reservoirs and the proposal to license plant operators and to grade treatment plants was discussed.

MEETING OF THE NEW YORK STATE SEWAGE WORKS ASSOCIATION

THE Spring meeting of the New York State Sewage Works Association, held in Rochester, N. Y., on June 9th and 10th, was attended by something over 150—the actual registration being 130.

A. F. Dappert, President of the Association

Twenty-five manufacturers had exhibits and a unique feature, introduced for the first time at this meeting during the first day's luncheon, was the review of "What's to Be Seen Among the Exhibits." C. P. Hevenor, Chairman of the Committee on Exhibits, stated briefly what the various exhibits featured and introduced the representatives of the twenty-five companies. In this way the members and guests became acquainted with the manufacturers' representatives and the nature of the exhibits.

The annual banquet was followed by a cabaret and dancing by all.

Saturday afternoon was devoted to an inspection trip to the trickling filter plant at East Rochester and the new activated sludge plant at Newark, N. Y., which is the first in the East to make use of the Dorr system employing paddle wheels in combination with air diffusion. This plant was found to be performing in an exceptional manner and at operating costs to be considered extraordinarily low for a plant of such small capacity. (For a description of the Newark plant see WATER WORKS AND SEWERAGE for May, 1933).

In the business meeting, Secretary Bedell reported the association to be the largest in membership of any of the associations in the Federation of Sewage Works Associations. There had been added 22 new members since January 1st, making a total of 262 members at present. Election of officers takes place at the January meeting each year and therefore no election was held. The association now holds three meetings each year—the Fall meeting to be held in October at White Plains, N. Y. There is, however, some thought being given to elimination of the Fall meeting after the present year.

Sunrise Breakfast Repeated

The "Sunrise Breakfast" featured at the meeting last Fall was repeated. Following the breakfast the "Question Box" was opened by Morris Cohn and C. C. Agar and the always interesting questions were put to the various members for answer which constituted an excellent method of starting "round table" discussion of the most valuable and spontaneous variety.

Resolutions

Among the several resolutions drawn was one particularly emphasizing the value of the new National Relief Act then in the course of passage by Congress. The resolution urges municipalities needing sewerage, sewage treatment facilities, or sewerage improvements to take immediate steps toward preparation of plans in order to be in readiness to apply for funds under the new act.

Papers and Discussions

Lack of space will preclude more than brief coverage of the papers read—some being entirely omitted except for title.

"Some Things Learned About Sewage Aeration by Diffused Air"—F. C. Roe, Engineer, The Carborundum Co., Niagara Falls, N. Y.

Mr. Roe reviewed the developments in aeration of sewage—saying that the spiral flow process had proven more practical than the ridge and furrow design because 25 per cent of the air could be thus saved and the more practical coarse grained diffusors could be employed. Recent experiences had shown that a minimum tank depth of 15 feet was essential in spiral flow tanks but that the surface of the tank might be greater in ratio to depth than heretofore accepted—i. e., a 15-foot depth tank might be 33 feet wide and thus reduce construction costs without increasing power costs. High power costs could be offset by long period aeration. Air consumption of 1.06 cubic feet per gal. had proven the average requirement but that paddle wheels in combination with diffusors had reduced that figure appreciably. In any event the diffusor area should total 10 per cent of the tank surface area as a minimum requirement. Mr. Roe stressed the value and merits of the removable tubular diffusor over the diffusor plate fixed at the bottom. He referred to the advantages of improved plate holders made of aluminum. To clean plates or tubes Mr. Roe said that the most satisfactory scheme consists of removal, drying and burning out the plates or tubes in a furnace at about 700 centigrade. Such treatment had restored 90 to 95 per cent of the original permeability. Soaking in acids had been the next best and in instances passing chlorine gas through the diffusors had been very helpful.

A. B. Holstrom of The Norton Company, Worcester, Mass., gave the association the benefits of recent observations he had made abroad, including a description of the new 10 m.g.d. plant for London. He had found the ridge and furrow tank preferred in England because of the strong sewages. He agreed that air bubble size was unimportant within bounds and therefore recommended plates of 30 permeability and higher. Clogging of diffusors continued to be the most serious obstacle. He pointed out that for each 1/10th pound of air pressure per minute per square foot saved, there results a saving of $3,000 per year on power.

"Vacuum Filtration in Sewage Treatment," by **Wm. Gavin Taylor,** Cons. Engr., Newark, N. J.

Mr. Taylor's paper dealt with the possibilities of sewage treatment wherein vacuum filters could be employed to remove the suspended matter from sewages or from effluents from chemical treatment or biological processes. Such practice had been used for years in connection with recovery of pulp paper mill effluents. Special reference was made to the

installation of such filters now under way at the Rockville Center, L. I. (3 m.g.d.) sewage treatment plant which employs pre-settling and the activated sludge process. Arrangements of the four units would allow dewatering of sludge, filtration of effluent and filtration of settled sewage to reduce loadings on the aeration tanks. The operation of the filter entails the use of pulp from waste paper added to the influent to produce a mat on the filter, the pulp being reused until the cake contains equal weight of sewage solids and paper pulp. The cake is then to be removed from the process and incinerated or delivered to sludge digesters already in use. Mr. Taylor said that the guarantees of the Municipal Sanitary Service Corp. called for removal of all but 10 per cent of the organic solids from crude sewage and all but 1 part per million of suspended solids in the activated sludge effluent. Power consumption is guaranteed not to exceed 300 k.w.h. for filtering the 3 m.g.d. plant output.

Arthur Wright, inventor of the filters, said that the idea was merely an adaption of long practice in pulp recovery from paper and pulp mill waste water.

Glenn D. Holmes, Consulting Engineer, Who Designed Newark, N. Y., Treatment Works

W. A. Ryan, Consulting Sanitary Chemist, Rochester, N. Y.

E. D. Flynn of Oliver United Filters, said that sewage sludge could not be successfully incinerated in garbage incinerators because of the 30 per cent ash content found in sludge. It had been necessary, therefore, to develop a new type incinerator for sewage sludges.

Symposium on Operation of Small Plants

Under leadership of **W. A. Ryan** a highly interesting symposium was participated in by operators of small treatment works. Mr. Ryan's introductory remarks called attention to the A.B.C. of successful operation which signified Attention—Business Like Methods and Cleanliness. The motto for operators might be, "Take care of your job and your job will take care of you."

"Problems in Separate Digestion of Sludge" were discussed by **Arthur Cary** of Fairport, N. Y.

Mr. Cary had found that adding lime for sludge alkalinization could be improved by making up 50 lbs. of hydrated lime in 6 buckets of hot water, and the suspension added to the sludge during recirculation with a diaphragm pump. He had had difficulty and an odor nuisance when dewatering secondary tank sludge on sand beds until he had tried the addition of chlorinated lime to the tank which was cut out of service and allowed to stand 3 days before withdrawing sludge. The sludge then dewatered readily without odors and the handling of the more concentrated sludge was simpler.

"Foaming Troubles," always an interesting topic, were related by **Harold Deming** of East Rochester, N. Y. Oil in the sewage had created most of the trouble and lime addition, while helpful, had not been as effective as drawing off a good volume of sludge.

"Beautification of Plant Grounds" was the topic assigned **William Eckert** of Rochester, N. Y., who said that "Single Prairie" rambler roses planted along fences had been about the most effective of all plantings. Rather than lawn grass on slopes the use of cranberry and barberry bushes had been more practical and less expensive to keep up. Scotch pine was a cheap and effective tree at only $4.00 per 1,000 from the State Forester and they had planted out 5,000 of these trees. Dogwoods, and flowering cherries were other trees used effectively. He had found it possible to trade sludge to florists or nurseries for shrubbery and therefore did not need to secure an appropriation to cover all of the planting.

"Sludge Drying on Covered Beds" was discussed by **A. W. Evans** of Tonawanda, N. Y.

Mr. Evans recounted experiences with glass covered and open beds in which 5 drawings of Imhoff sludge per year on open beds had been supplanted by 10 drawings on covered beds. An eight inch depth of wet sludge applied could be removed in 14 to 18 days in summer and in 4 to 5 weeks in winter. The cake would be from 4 to 5 inches thick. The 10,000 square feet of bed surface had required 100 tons of new sand to replace 3 inches removed with the sludge. He felt that the side walls of covered beds should not be higher than absolutely necessary because of reduced ventilation and shading of the edges which remained wet longer.

"Operating Routine and Operating Records" was the topic assigned **John Nelson** of Woodlawn District Plant in Hamburg, N. Y. Mr. Nelson being unable to attend, **C. C. Cotton** of Buffalo related the routine followed by Mr. Nelson, the results of which told in plant operation. All pump sumps are cleaned monthly of accumulated sludge and the final settling tanks were cleaned monthly whether they needed it or not. The distributor lines on the sprinkling filters are blown out weekly and the chlorinators are cleaned weekly and kept greased. Residual chlorine tests are made three times daily and chlorine feed is changed to meet changing conditions during the day and to effect economy. Routine laboratory tests were made daily and sludge records were very complete.

"Prechlorination" as practiced at the Dundee, N. Y., plant was discussed by **John C. Strowbridge,** operator of that plant. He described the tangential flow mixing chamber ahead of hopper bottom settling tanks and the effects of prechlorination in holding septic action in check. That had allowed the tanks to be operated in rotation as settling tanks then cut out of service and the sludge allowed to digest in the same unit. Eventually a separate digester would be provided but for the present one unit in service and the other digesting was serving the purpose. The solids from the chlorinated sewage, strangely as it might seem, had digested rapidly and thoroughly without seeding of any kind. Sludge was pumped out only every 80 days. Prechlorination had produced a clearer effluent, eliminated odors, lessened work of the operators and the sludge had apparently digested better. The cost of chlorine had averaged $1.19 per day—for treating 100,000 gals. of sewage per day.

Selecting Durable Equipment

"Selection of Sewage Plant Equipment"—John Lewis, Engineer in Charge of Operation and Maintenance, Department of Public Works, Rochester, N. Y.

Based upon experiences during 10 years of operation of 9 pumping stations and 4 treatment works on Rochester's sewerage system, Mr. Lewis had some timely suggestions to make in the matter of selection and care of sewerage equipment.

In pumping sewage he had found the float control more reliable than the air bell control. For wire conduits hot dipped galvanized pipe had proven fairly satisfactory. No pumps were absolutely non-clogging and arrangements should always be made for easy access to the impeller chamber. Shafts should be liberally supplied with flexible couplings and bearings should be numerous and wide. Motors should never be enclosed and open phase relay protection was very important. His experience with packings to prevent grit cutting of pump shafts had shown this item to be one not completely solved.

At sewage treatment plants corrosion had been a serious factor and replacements of corroded equipment had been made with high chrome-silicon iron. For lubrication he had found the high pressure grease system the most satisfactory. Accessibility of greasing points could not be over stressed. Summing up, he felt the three important factors in mechanical devices were—minimum number of moving parts, resistance to corrosion and accessibility.

W. P. Gyatt of Syracuse said that they had tried a dozen packings for pump shafts and believed that Garlock No. 147 (asbestos and graphite) to be about the most satisfactory one tried for shaft speeds up to 900 r.p.m.

Benjamin Eisner of Newark, N. J., called attention to a packing of flake graphite and lead which could be squeezed into the glands just as one does grease from a grease gun. Experience with such packing had been highly satisfactory where trouble from grit had been experienced.

Mr. Lewis brought out the fact that low speed pumps had given no particular trouble from grit cutting but those running between 1,200 and 1,800 r.p.m. had been the trouble producers.

Description of Plants

"Features of the Revamped Plant at Newark, N. Y."—Glenn D. Holmes, Consulting Engineer, Syracuse, N. Y.

Mr. Holmes described the conversion of the old sprinkling filter plant at Newark into a modern activated sludge plant employing such features as combination of paddle aeration and diffused air, power generation by gas engine (using sludge gas) with heat recovery units, a Venturi flume and meter, and glass enclosed sludge beds constructed on the old filters. (For a detailed description of the plant see WATER WORKS AND SEWERAGE for May, 1933.)

Mr. Holmes stated that the plant designed for 10,000 population was now treating 0.8 m.g.d. at a cost of $14.50 per m.g. since the gas engine at a cost of $120,000 had been put into operation. When purchasing all electric power used the cost had averaged $22.00 per million gallons and therefore the gas engine had saved about $7.50 per m.g. Gas production had averaged 1.08 cubic foot per capita.

A. J. Fisher of the Dorr Company presented some operating observations to show that best results had been obtained when carrying 1,500 p.p.m. suspended solids (dry weight) in the aeration tanks. He said that gas production had been 16.9 cubic feet per pound of volatil solids destroyed. Suspended solids in the effluent had varied between 5 and 15 parts per million.

The operating staff of the plant consisted of two men on duty (8 a. m. to 5 p. m.), but none at night. The paddle wheels had kept the aeration tanks in good condition, even though the air had been stopped on occasions during the night. The gas engine operation had not required the entire digester output and had operated on 20 cubic feet of gas per brake h. p. hr.

"Operating Experiences at East Rochester, N. Y." —R. G. McDonald, Village Engineer, East Rochester, N. Y.

An interesting unit in the East Rochester plant is the double deck circular tank—the upper story being a settling unit with Dorr clarifier mechanism. The

Dr. A. J. Fischer of the Dorr Co., Who Has Been Making Studies of the Performance of the Newark Treatment Works

W. P. Gyatt, Engineer, Sewer Board, Syracuse, N. Y.

solids are swept to the trapped center opening entering the lower digestion compartment equipped with sludge and scum stirring mechanism. Gas vents of the lower compartment are around the periphery. The vents have lately been capped and a gas holder installed, digester liquor is recirculated through heating coils and returned direct to heat the lower digester. The plant treats 350,000 gals. per day on the average with maximum flows reaching 800,000 gals. per day. The sewage passes through a Dorr Detritor and fine screen prior to sedimentation. Secondary treatment is provided by sprinkling filters and final settling tanks. Sludge beds are not covered.

Operating difficulties met with included foaming of the digester for the first three years which brought on ponding of filters. Cost of operation totals $3,000 per year divided between $2,400 for labor and salaries, and $300 for power. The plant designed by John F. Skinner had cost $185,000 to build. It is proposed to install a gas engine to produce power required to run the plant and heat recovery for the digester.

The Jamestown, N. Y., plant was described by **L. A. Bergman,** Director of Public Works, Jamestown, N. Y., a feature of which is the water wheel for producing power from the head available between the plant and the stream. The plant effluent is chlorinated during the summer months only.

Burdette Cleveland, Consulting Engineer of New York City, pointed out the low cost of the plant, viz., $3.60 per capita.

THE SEWAGE TREATMENT WORKS OF SOUDERTON, PENN.

By CHAS. F. MEBUS

Consulting Engineer,
Glenside, Pa.

THE Borough of Souderton is located in the northwestern corner of Montgomery County, Pennsylvania. It is, for the most part, a residential community in an agriculture district.

The population (1930 census) was a trifle less than 4,000 and the sewage treatment plant was designed for a population of 5,000, which in all probability will be ample for the next fifteen years.

The sewage is collected by a system of sewers, mostly old, some of which take only domestic sewage and some of which are combined storm and domestic sewers. At the time of construction of the sewage treatment plant, the intercepting sewer was constructed from the treatment plant site along the Little Skippack Creek through the center of the Borough, and was connected to all existing sewers which could be located. It was necessary to build storm water regulating manholes at several points where combined sewers were connected. Not all the sewers drain to the sewage plant, as a part of the Borough is on another watershed. The present dry weather flow is about 220,000 gallons. During storms the flow goes up to 500,000 gallons.

Although there are a few small industries in the Borough they are of such a character that there is no serious trade waste problem, being clothing factories, cigar factories, furniture and two small slaughter houses. The only wastes to be treated at the plant are the spent water from the factory toilets and lavatories and the slaughter houses.

The treatment plant as constructed consists of the following units: bar rack, detritor, electric flow meter, Imhoff tank, siphon chamber, and dosing tank, sprinkling filter, secondary settling tanks, glass covered sludge drying bed and a combined sludge pumping, chlorinator and laboratory building.

Primary Treatment

The bar rack is made in two sections of galvanized wrought iron bars with a clear opening between bars of one and one-half inches. Entire frame is electric welded. The cross bars are all under the main bars, so there is no obstruction to raking. The rack is hand cleaned.

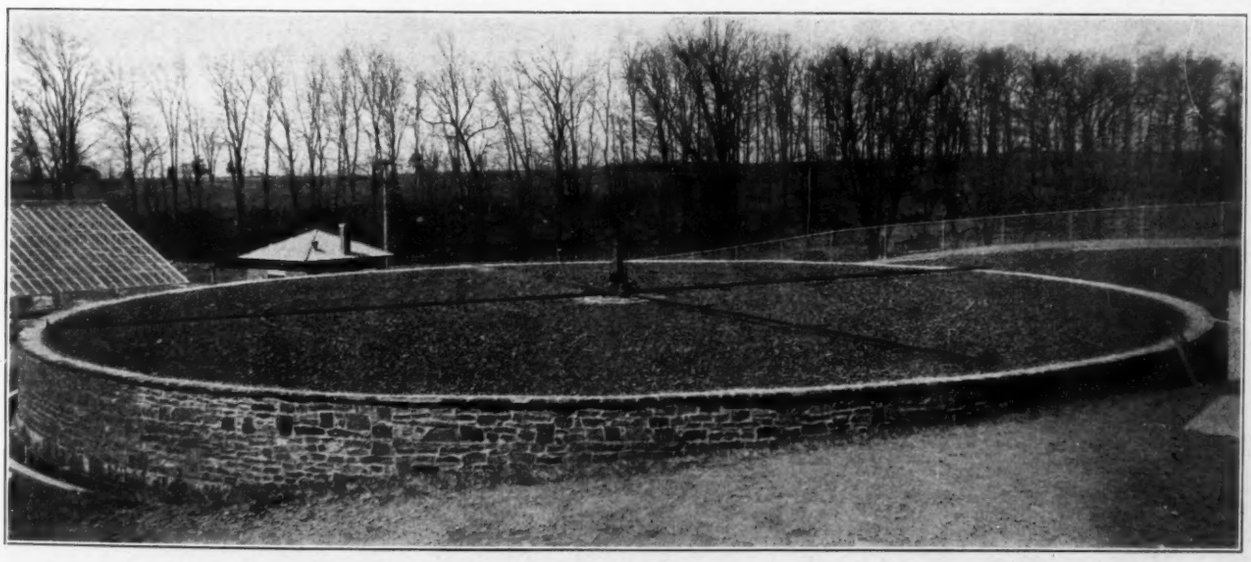
Immediately following the bar rack is a Dorr detritor. This machine is set in a concrete basin constructed with adjustable weirs so the velocity can be controlled to assure the deposition of the grit. The mechanism collects the grit in a sloping channel where it is caught by a raking mechanism and discharged into a wheelbarrow. The grit is washed free of organic matter as it is drawn up by a propeller, before being discharged. The organic matter washed out of the grit is returned to the basin through a separate channel.

The sewage after leaving the detritor flows through a venturi tube set in a special manhole. The flows measured at the tube are indicated, recorded and registered in a meter located on a panel in the chlorination house. The meter is electrically operated by means of General Electric Selsyn motors.

The Imhoff tank is rectangular in shape with two parallel flowing through compartments and with dual hopper bottoms in the sludge digestion compartments. The hopper bottoms are in the form of inverted rectangular pyramids. After due consideration it was not deemed advisable to make provision for gas collection. The channels are so arranged that reversal of flow can be effected quite easily.

Sprinkling Filter

The clarified sewage from the Imhoff tank flows to the siphon chamber and is then discharged on the trickling filter bed. The filter bed is provided with an Adams Rotary distributor. The distributor consists of four arms perforated on one side and so arranged that upon the discharge of the siphon the sewage flows up through a central mast and out through the perforated arms. The sewage flowing through the perforated arms furnishes the power for rotation. The perforations are so



The Sprinkling Filter of the Souderton Plant

arranged that no two are at the same distance from the center of the distributor. The ultimate result is that practically perfect distribution is effected. The size of the siphon chamber was designed to effect numerous short runs rather than fewer long runs. The rotating arms are supported by guys attached on the central mast. The arms can be cleaned by lifting small shear gates attached on the outer ends. The perforations can be cleaned by using a stiff wire. The filter bed was constructed of crushed trap rock with an average depth of six and one-half feet and with masonry side walls. The diameter of the rotating arms is 110 feet. The under drains are laid radially and drain to a circumferential channel pitched to a single outlet.

Chlorination and Sludge Handling

The oxidized sewage then passes through a chlorinating channel and then into twin rectangular secondary settling tanks. The settling tanks are provided with piping have flexible connections to permit removal of the supernatant liquor. Normally the clarified effluent flows over a weir and into the plant outfall sewer and subsequently into the Little Skippack Creek. The sludge from the secondary settling tank can be pumped either to the Imhoff tank for consolidation with the primary tank sludge or pumped directly to the sludge drying bed.

The sludge drying bed is completely covered by a glass enclosure provided with ridge, hip and gable end ventilators. The moisture drained from the sludge flows to the chlorinator manhole and continues on with the clarified sewage. The sludge bed enclosure is provided with a manually operated monorail carrier suspended from the roof trusses. The dried sludge can be stored temporarily on a drained concrete platform while awaiting removal.

The building houses a plunger type sludge pump, W & T vacuum type chlorinator, electric flow meter and a small laboratory table. The necessary tools for plant operation was included in the contract for construction as was the laboratory equipment. The laboratory equipment is adequate for performing tests for settleable solids, residual chlorine, hydrogen-ion concentration, and relative stability. The borough has engaged a plant operator who is on duty during the daylight hours only, and during heavy rains.

The plant has now been in operation for over one year. It produces a uniformly clear and stable effluent. It is free from objectionable odors. The sludge after being dried, is taken by neighboring farmers.

The contractor was Engstrom & Wynn, Inc., of Wheeling, W. Virginia. The plant was designed by and constructed under the supervision of the author.

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L. A. Day Opens Consulting Offices

Leonard A. Day, former Commissioner of Water at St. Louis, Mo., having served the St. Louis Water Department for 30 years, announces the opening of consulting engineering offices at 3829 West Pine St., in St. Louis. Mr. Day will specialize in the municipal and industrial water supply work.

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A Correction

We are informed by C. H. Capen, formerly Assistant Engineer of the New Jersey State Health Department, that the New Jersey Licensing Act, referred to in our issue of April, 1933, as having been in operation since April, 1926, in reality dates back to February 9, 1918—being designated as Chapter 23 of the Pamphlet Laws of 1918. Examinations of applicants for a license were started in 1919.

In 1926 there were apparently many revisions made and further revisions have been made during the past year.

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H. H. Horner

H. H. Horner

Harry H. Horner, vice president and general manager of the American Water Works and Electric Utilities at Birmingham, Ala., died on June 15th, in Birmingham. He was 49 years old, was born in Muncie, Ind., and received his education at the University of Missouri. He leaves a widow, three daughters and a son.

Harry—as he was known to all his friends, of which he had many—literally grew up in the water works business. His father was superintendent of the East St. Louis plant where Harry learned the business early and where his brother, C. M. Horner, is now superintendent.

Prior to coming to Birmingham as superintendent of the Birmingham Water Works Company plant in 1912, he had been in charge of the American Water Works and Electric Company's plant at South Pittsburgh, Pa.

Harry Horner had a laudible hobby—a deep interest in giving unprivileged children a chance. A boy's camp established on the Birmingham Water Company's property is known as Camp Harry Horner.

Mr. Horner was instrumental in building good-will of the finest sort for his company in Birmingham and he was a valued citizen to the community in many ways. He was admired and loved by all who knew him.

He had been for several years a member of the American Water Works Association, and was a member of the Southern Club, Rotary Club, Birmingham Country Club, and Chamber of Commerce. He was a Mason, a Shriner and a member of the Sigma Chi Fraternity.

Birmingham has lost an outstanding citizen—the American Water Works and Electric Company a valuable manager.

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Bridge Dam Bill Enacted

Enactment by the Ohio legislature of the McManus bridge dam bill is expected to exercise an important influence on water conservation in Ohio. According to Ohio Health News, the act sets up the procedure and makes possible the building of dams in highway bridges through cooperation of the State Highway Department, Department of Public Works, Conservation Commission, county, township and municipal authorities and private individuals or groups.

Proponents of the measure pointed out that in times of extreme drought, many farmers must carry water for miles to water their stock or for domestic use, and that during the last three years many municipalities had to haul water long distances by rail or in tank trucks to maintain their domestic supplies. As dams impound water and conserve it for use during drought, the bridge dams, once installed, are expected to be an important factor in negativing this necessity.

MAINTENANCE OF WATER METERS—READING AND BILLING

As Practiced at Baltimore, Md.

By J. S. STROHMEYER

Distribution Engineer, Bureau of Water Supply, Baltimore, Md.

THE Bureau of Water Supply is the successor of the Baltimore Water Company, a corporation organized in 1804 for supplying the city of Baltimore with water. The company's property was purchased by the city in 1859, and from that time it has been operated by the municipality.

The report of the Water Board for 1869, shows that in March of that year, 29 water meters of the duplex piston type were installed, apparently the first meters to be installed in Baltimore. The growth of metered water services was slow, and it was not until 1918 that the Bureau had approximately 4,300 meters, which were all installed on industrial and commercial supplies. As of January 1, 1933, however, there were 55,558 metered services, located in Baltimore City and Anne Arundel and Baltimore counties.

The reading and maintenance of water meters is done by the Bureau of Water Supply, and the billing and collecting of accounts by the Bureau of Receipts.

The organization for the maintenance of these meters is centered at the Mt. Royal Maintenance Headquarters under an Assistant Maintenance Engineer, who reports directly to the Engineer of Maintenance. The personnel in the shop consists of a Junior Civil Engineer in charge; a Junior Clerk for keeping records and filing; a Handyman for testing; a Meter Repairman, and three laborers. The laborers disassemble the meters, clean the parts for the Meter Repairman, help on testing and do other miscellaneous shop work.

Shop Practice

The meters are tested in the shop on three test benches. The ⅝ in., ¾ in. and 1 in. meters are tested in series on No. 1 bench. The 1½ in. and 2 in. disc and compound meters are tested singly on another bench, and the larger size meters, from 3 in. to 12 in., are tested on the third bench.

The field force consists of two crews with trucks, and two handymen each with a Ford truck. Each crew consists of a meter repairman and a laborer. The repairmen make all the major repairs, and are supervised by the Junior Civil Engineer in charge of the repair shop. We have not found it economical to make field repairs on meters 2 in. or less in size. Such meters are removed and repaired in the shop; being replaced by a meter of similar size.

The handymen and truck are used on general work such as replacing broken registers and glasses, installing small meters, removing meters for a vacancy, delinquency, or replacing for repairs.

In making repairs to the larger size meters (3 in. or over), the part of the meter requiring replacement is furnished by the Repair Shop and is assembled in the field.

Water meters 2 in. or larger in size are read at two-week intervals and a close check is kept on any falling off in registration as an indication of the need for repairs. The books containing these accounts are called large meter books and are closely scrutinized in the office of the Meter Division for such indications. It frequently happens that the decrease in registration indicates only a decrease in consumption.

The Junior Civil Engineer in charge of the meter shop has charge of these inspections, and by investigation or testing the meter determines whether the decrease in registration is normal or is caused by the failure of the meter.

Cost of Maintenance and Repairs

The total maintenance expense of the Bureau from 1927 to 1931, inclusive, was about $2,294,000, of which $250,000 was for meter maintenance, representing about 11 per cent of the total. As our cost records for meter maintenance includes both the repairs to meters and meter vaults, the percentage of meter maintenance to the total maintenance expense cannot be ascertained. I might add also that the rates of the expense and maintenance of meters and meter vaults, to the total operating and maintenance expense of the Bureau for the same period of time was 4.3 per cent of the total.

From our repair shop records, the annual average cost of repairs to ⅝ in. or ¾ in. meters, representing 92 per cent of the total number of meters in service, was 22 cents per meter in service. This repair cost is the average for the 6-year period, 1927 to 1932, inclusive.

As a matter of interest, I will give some figures worth while mentioning. Our records show that the cost of repairs to five ⅝ in. meters installed 30 years ago has amounted to an average of 18 cents per meter per year. The combined registration of these meters was almost 750,000 cubic feet or an average cost of repairs per 1,000 cubic feet registered of approximately $0.035. Also, on five ¾ in. meters that have been in service for 32 years, the average cost of repairs amounted to $0.135 per year.

Reading Practices

When an application is received for a water supply service it is sent to the Service Division for inspection as to the location of the service in the field; then to the Maintenance or Construction Divisions for the installation of the service and meter yoke. Generally the meter is not installed on ⅝ in. or ¾ in. services until we are requested by the consumer. The installation can be made within 4 hours after receipt of notice. In some cases, however, the small meters are installed at the time of installation of the service.

After the water supply service and meter is installed, the application is forwarded to the Meter Division and the new account is opened. It is then given an account number and is routed in the meter readers' handbook. An authorization is sent to the Bureau of Receipts to make an addressograph plate on which appears the consumer's name, address and meter account number. The addressograph plate is then filed in its proper rack and is used quarterly for billing. From this same plate an impression is made on a handbook page, a ledger card and a file card, all three being forwarded to the Meter

Division. The Meter Division enters on the handbook page and cards the size, kind and number of meter, the date of installation, the reading at installation and other sundry information which may help the reader to locate the meter on the premises. The account is then ready for reading and billing.

The meters are read quarterly by men who have passed a competitive meter reader's examination and are certified to the Bureau as Meter Readers by the City Service Commission. After their selection, the Meter Readers are given an intensive course of instruction in the meter repair shop so that they can recognize the different types of meters and registers and be able to discern defective or non-registering meters.

Each reader's equipment consists of a meter reader's hammer, flashlight, and a 1-inch paint brush which is used to clean the glass register cover. The meter books contain from 80 to 260 accounts, depending on the area covered. Each book represents one day's work.

The reader is required to record the statement of the meter, and make the extension on the handbook page. If the meter shows very little or no registration from the previous reading, the reader is required to ascertain whether or not the meter is registering, by requesting someone on the premises to turn on the cold water faucet and by observing the test hand on the meter. If the meter is not registering, a notation is made on the handbook page. The reader is instructed to report any unusual condition or defect that he may find in the meter, meter vault or meter cover, noting the condition on the handbook page.

Meter Reader Reports

As an aid to the meter reader, there is inserted in each book a list of conditions that are to be reported, each one opposite a number. There are 29 such conditions, and by noting the number on the page, it keeps the book neater and helps the reader. For instance, No. 1 "is meter not registering"; No. 6, "broken glass" and No. 27, signifies, "no one at home."

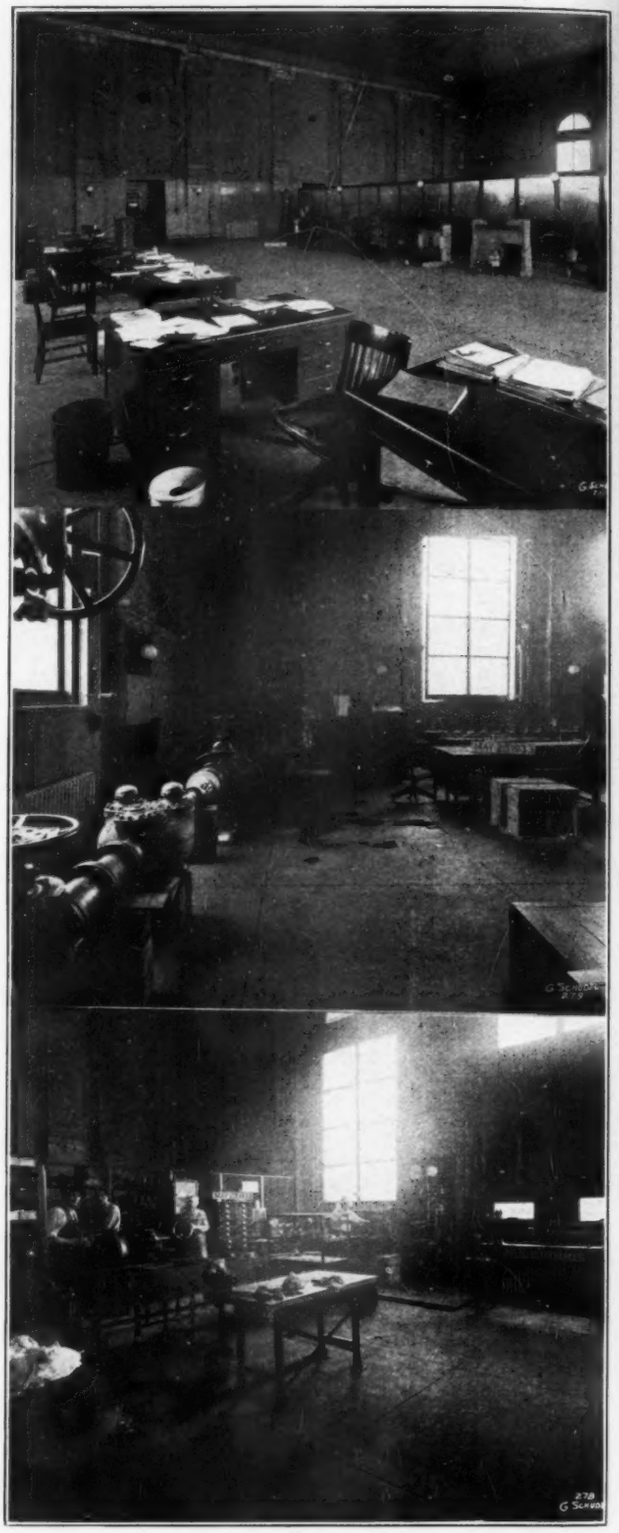
Upon completion of the book the reader is through for the day. The book is then brought into the office the following day and he receives another book for the current day. When the book is returned to the office it is referred to a clerk who checks the extensions on each account, and in cases where an abnormally high or low consumption is recorded, the reader not having fully ascertained any cause for this unusual consumption, a "re-read" sheet is made up by the clerk to be sent out and read by an inspector, who makes extensive efforts to locate the cause of the abnormal or subnormal consumption. Also, the clerk notes the defects reported by the reader and issues a work order on the Maintenance Division for the correction of the condition.

When the "re-read" sheets are returned they are entered in the handbook, and it is ready for billing. Before submitting the book to the Billing Department of the Bureau of Receipts, the readings and extensions on the handbook page are checked and copied on a ledger card which is a duplication of the handbook page. This card is filed insuring the Meter Division of a duplicate record which can be referred to when the handbook is unavailable or in the event of the book being lost, it can be duplicated.

Upon completion of the billing by the Bureau of Receipts the book is returned to the Meter Division where it remains until the next quarterly read.

The Meter Division keeps a card index of every meter account which is filed alphabetically by street names and numerically by house numbers. On this card is an impression of the addressograph plate and the size, kind, and serial number of the meter. This card file is used to locate an account in the handbook.

The average number of meters read daily per man is 144. Should the city become universally metered, this average would materially increase, and the cost per reading would be proportionately reduced.



Upper: Maintenance Headquarters, Baltimore Water Department. Middle: Meter Test Room, Mt. Royal Station, Baltimore Water Department. Lower: Meter Testing and Repair Shops, Mt. Royal Station, Baltimore Water Department

Cost of Meter Reading

I have prepared a comparative statement showing the quarterly cost of reading a meter account for the years 1929 to 1932, inclusive. This cost includes expenses for salaries, transportation, and miscellaneous expenses appertaining to meter reading but does not include overhead and office expense:

Year	No. Metered Services	Quarterly Reading Cost per Account	Decrease
1929.....	46,834	$0.1071	.....
1930.....	50,728	.1043	.0028
1931.....	53,708	.1041	.0002
1932.....	55,558	.1026	.0015

This table shows that the cost has been decreasing each year. The cost of reading 17,464 meters during 1922 was $0.165 per quarter. Incidentally the number of meters read daily per reader has increased from 93 reads in 1927 to 144 in 1932.

We consider this increase in daily readings the result of the large increase in the number of meters installed in meter vaults, the increasing number of metered services each year, and the re-routing of the meter accounts in the books.

Billing

The cardboard form is 3½ by 18 inches; this is perforated in the center, forming two cards each 3½ by 9 inches. This form is passed through the addressograph machine, and after the consumer's name, address, and the account number is stamped on it three times, it is ready for the billing on two Underwood billing machines. The billing machine operators average about 350 bills daily per machine. These operators type on the form, which is folded on the perforation, the date of the meter reads, size of meter, extension, any delinquency, and total amount of bill. This information is duplicated by carbon paper.

The billing machine give the total of the consumption and the amount of revenue for each book so that the revenue can be checked. This revenue is compared with that of the previous quarter for statistical purposes. After the bill has been typewritten, the ledger stub, which is one-half of the form, is torn off and used as a customer's ledger, being filed in the Bureau of Receipts to correspond with the meter handbook and page. The other half, consisting of the consumer's bill and cashier's stub, is mailed to the customer. When making remittance, the consumer tears off the cashier's stub and mails it with his check, keeping the bill. If the remittance is made personally, the bill is receipted and returned to the customer, the cashier's stub being retained. The receipted cashier's stub is posted to the customer's ledger at the close of each day. Payment may be made at the Municipal Office Building or at the banks authorized to collect taxes.

The average time between the reading of the meter and the receipt of the bill by the customer is 10 days.

Five different colored bills are used, designating the respective rates applicable to consumers in Baltimore City, two rates in the Baltimore County Metropolitan District, Anne Arundel County, and a special rate for hydraulic elevators, charitable institutions, hospitals, etc.

Complaints

Complaints are referred to the Meter Division, where they are noted on forms and forwarded to inspectors. Each complaint is investigated by reading the meter, noting the condition of the dial and glass, and observing whether there is any interior or exterior leakage. After these observations are made and the results recorded, the form is returned to the office and a letter written to the consumer apprizing him of our disposition of the case. If an error is made affecting the total of the bill, a Revision of Charges sheet is sent authorizing the Bureau of Receipts to make the correction and send the consumer an adjusted bill.

For the past half century the water meter has played a very important part in the constantly improving technique of water works operation. In the face of early indifferences and adverse propaganda, the number of meters has increased continuously until the meter has become an almost indispensable servant of every community having a public water supply. We consider the Meter Division has made substantial progress in the efficient handling of its meter accounts, and while we are aware that there is room for much more improvement, we feel we are working in the right direction.

Acknowledgment.—A paper read before the Four States Section of the A. W. W. A., April, 1933.

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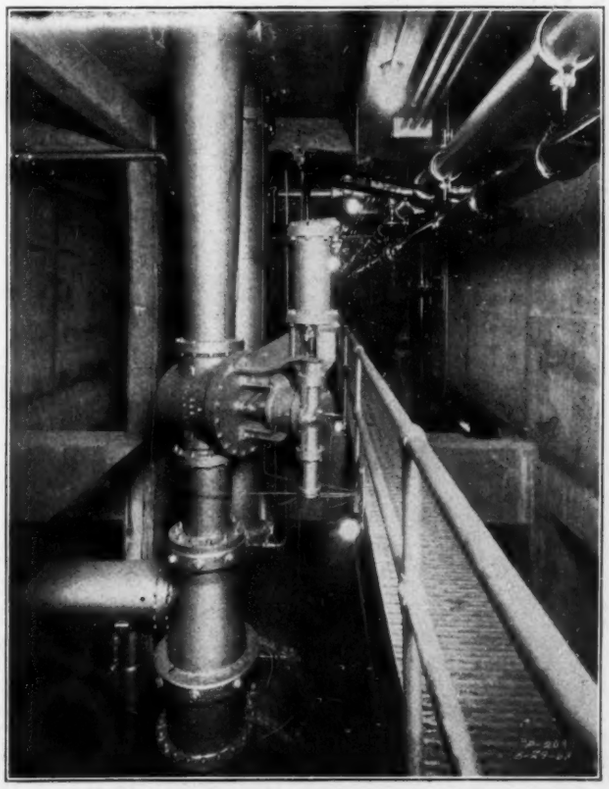
Bloomington Voters Approve Sewer Loan

At a special election the citizens of Bloomington, Ind., voted three to two to construct a new self-liquidating sewage disposal plant. The R. F. C. had already approved a loan of $428,000 on a like amount of revenue bonds secured by service charges on the sewer users. Bloomington was the first city in Indiana to exercise its borrowing power under the state's enabling acts, governing self-supporting improvements. Relief labor is to be used throughout and jobs for at least 600 men for six months are expected to result from the improvement. A major share of the construction will be of concrete. Mayor Campbell described the election as a case of "saving Bloomington from sewercide."



No—This Is Not the Pipe Gallery of a Filtration Plant, It Is the Air Line Pipe Gallery of Cleveland's Modern Sewage Treatment Works. The Venturi Meter and Cone-Valve in the Foreground Control, Measure and Record the Air Input to the Aeration Tanks. There Are 16 Such Meter-Valve Units Serving a Like Number of Aeration Units.

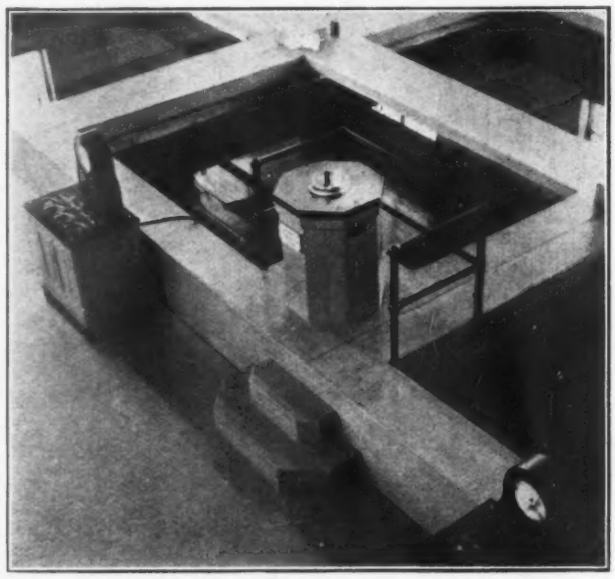
OBSERVATION STATION FOR FINISHED WATER RESERVOIR

By CARL LEIPOLD

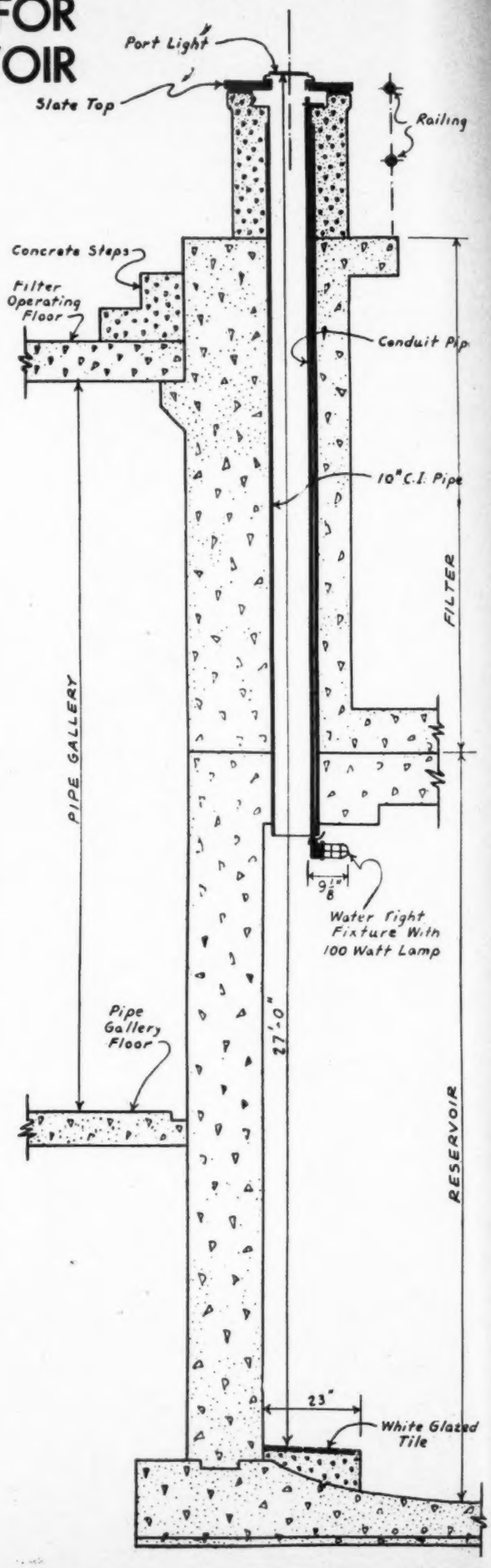
Superintendent, Walter Filtration Plant, Winnetka, Ill.

DURING the past ten years, a request most frequently asked by the visitors at the Winnetka water filtration plant was to see the water they drink. It was decided at the time of the extension to the water plant, recently put into operation, to install an observation station in the finished water reservoir. For favorable observation, experiments showed that the station had to be placed in as dark a location as possible and should not be in direct sunlight. The station was placed at the corner of the front and side walls of a filter, constructed over the finished water reservoir.

The observation station consists of a 10 in. cast iron pipe 13 ft. long imbedded in concrete and placed through the clear water reservoir ceiling, through the front section of the filter and 2 ft. 7 in. above the filter walls. The upper section of concrete is made in an octagonal design with a 2 in. slate top to match the tops of filter operating tables. A port light with chromium plated finish having a 9 in. diameter glass opening and hinged cover is securely anchored to the center of the slate top. The heavy duty water tight fixture with a 100-watt lamp is placed at the reservoir ceiling and supported by a conduit pipe running along the inner wall of the 10 in. pipe to the bottom of the slate top where it is connected to the electric switch. This arrangement allows quick and easy removal of broken lamps. The ceiling and side wall of the reservoir, for a distance of 6 ft., was painted with one coat of concrete sealer paint and two coats of white swimming pool enamel paint. The reservoir floor, directly beneath the 10 in. pipe, has an arrangement of white glazed tile with one black glazed tile placed in the center to attract the eye. A railing is assembled around the observation station on the top of the filter walls to prevent the observer from slipping or falling into the filters.



Clear Water Observation Station, Winnetka, Ill.



EDITORIALS:

An Important Supreme Court Decision Relative to Utility Values

UNTIL its recent decision in the Los Angeles Gas and Electric Corp. case the Supreme Court of the United States has favored reproduction cost less depreciation plus going value as the basis for rates. In this last decision there is much less definiteness as to the standard of value for rate making. It is true that the court still holds that "present value" and not "original cost" should be the rate base, but this apparently definite base is rendered rather indefinite by the ruling that the cost of reproduction is merely one relevant fact and does not furnish an exclusive test. In short, the Supreme Court has almost reverted to its original decision of two generations ago in the Smythe vs. Ames case, when it enumerated 4 factors that should be given consideration in arriving at a rate base, namely:

(1) Original cost plus additions.
(2) Market value of securities.
(3) Cost of reproduction less depreciation.
(4) Any other elements affecting value.

The market value of securities was soon abandoned as a factor, and has seldom been mentioned in recent court decisions relating to value for rate making. This left only two definite criteria of physical value, namely (1) historical cost and (2) reproduction cost less depreciation.

The Court now says: "The weight to be given to actual cost or historical cost and to cost of reproduction is to be determined in the light of the facts of the particular case." Since actual cost and reproduction cost often differ greatly, no criterion of rate value remains under this decision; for to say that the facts in each case must determine which is to be given the greater weight, is equivalent to leaving it to the discretion of the utility commission.

In the Galveston Electric Ry. case, in 1919, the Supreme Court held that the "present value" should be based on the prospective cost of reproduction at "normal prices." Prices then were abnormally high. Justice Hughes reiterates that decision when, in speaking of "present value": "Its purpose is to afford ground for prediction as to the future. It is to make possible an intelligent forecast of probable future values in order that the validity of rates for the future may be determined."

Public utility companies whose present rates are being attacked will doubtless lay great stress upon the fact that prices and wages are now subnormal. Hence their plants have a rate making value in excess of the cost of reproduction at current prices.

The Supreme Court dismissed the company's estimates of the "cost of financing" and "promoters' remuneration" as being too conjectural to be allowed. These elements of cost have never been favorably regarded by the courts, in spite of the fact that the "cost of financing" is seldom conjectural. Perhaps the habit of expressing it as a percentage has tended to give it an appearance of uncertainty.

The Supreme Court again refuses to give weight to actual deficits incurred in establishing a utility business. But since the court looks askance upon any estimates of such deficits in reproducing the property, a utility company is "left out on a limb." It is admitted by all students of the problem that "interest during construction" is a necessary element of cost. Almost as universal is the admission that there is a sequel to interest during construction that usually persists for several years after a plant begins operating. Yet when evidence is submitted showing what that "sequel," or "cost of developing the business," has been, the Supreme Court has brushed it aside on the ground that it is irrelevant; first, because it is "actual cost" and not "present value"; and, second, because it is of the nature of a deficit, which is not a capitalizable element. Yet the very same arguments could be used just as logically to exclude "interest during construction!"

The Supreme Court again sanctions a 7 per cent rate of return, as it did in the Indianapolis Water Co. case, for it says: "We find it impossible to hold that a rate of 7 per cent is so low as to be confiscatory." In the Indianapolis Water Co. case, the commission had named 6 per cent as a fair rate, but the Supreme Court raised it to 7 per cent. In the present case the company sought to secure the 8 per cent that the California Commission had been accustomed to allow until recently, but the Court refused to support that contention.

J. P. Gillette

Water Works Associations in Harness

NEVER before in the history of the American Water Works Association has its 2,400 members and its associate members been in the position that they are now in to do so much good during the next few months. That was made very plain during the recent Chicago convention of the Association, as reported elsewhere in this issue.

The Chicago address of Willard T. Chevalier, concerning the place of water works and water works men in the "new deal" to effect national relief and industrial recovery, was an outstanding and stimulating contribution to the efforts of the Association. It has been distributed in reprint form to the members. It is worth reading again by those who heard the address. The informative talk by the "wheel-horse" of the Association, Malcolm Pirnie, unfolded the proposed method of administering the new National Relief Act with particular reference as to how the financing of projects could be arranged. It embodied a presentation of a clean-cut analysis of the actual costs of public works projects contemplated in conjunction with the Relief Act. The moderate charges and ease of financing projects with the governmental grant were impressive. President Pirnie then unfolded the plans drawn by himself and the Association Directors, to get the machinery of the Association into prompt action to hasten the nation-wide development of water works projects and thus procure the advantageous financing before too late to do the maximum good. In the program outlined, every Secretary aid Chairman of the several State and Divisional Sections of the Association will automatically become an important unit in the plan conceived. These men who came to Chicago to attend the meting of this—shall we call it an "Energizing Council"—have returned to their homes with clear cut understandings and ideas of what

may be accomplished, what the obstacles are, and ways and means of overcoming them. Somewhat varied programs may have to be used in their respective sections of the country but basically all have the same problem—that of rendering local authorities every possible assistance in getting plans for water works betterments under way, the projects authorized by the local administrative officials, and most important of all, the whole-hearted support of the tax paying public. Once this has been accomplished these men, where advantageous, will work with the District Federal Administrators of the Relief Act in order to speed up the needed approval of the project and procuring of loans and the supplemental grants from the government.

During the Chicago convention a Central Relief Committee of seven active and seven advisory members was appointed. Of this, the president is chairman and P. S. Wilson is serving as executive secretary, with an office established at Association headquarters. In addition, each local section of the Association has, or will have, its Sectional Relief Committee—to be as large as need be to thoroughly cover its territory. The New England Water Works Association and the Southwest Water Works Association have agreed to direct their efforts through the Central Committee of the American Water Works Association to the extent of functioning as Sections of the Association, thereby showing a laudable spirit on the part of officers of these Association in their desire to add strength and unity to the movement started by a sister Association. State Associations, not now sections of the A. W. W. A., have acted likewise.

Our Sectional Relief Committee members have a real and important job to perform—a call to duty to association, profession and country; a call to arms against a depression which has already had its first lines badly broken. Their task is no simple one and each and every member of the American Water Works Association can and should do his "bit" by calling on Field Headquarters to send "forces" into his community to help him initiate or put across a project he may feel to be feasible and desirable, regardless of its size. Members of the Association and others should offer their assistance to these men, with whom the success or failure of the Association's campaign rests. They are the field officers at the front and will get all of the support they ask for from Central Committee Headquarters, but it is frequently the scouts who are responsible for victory in the field—therefore, let every member of the Association act as volunteer scout in the campaign under way.

State Health Department Engineers can and will play a most important part in the program. They have already started action and know where improvements are needed and how best to proceed in getting the project under way. There will be hand-in-hand work to be done between the Section Committees and the Engineering Divisions of State Health Departments to increase the force behind the movement. Consulting engineers will take important parts and have much work to do. Water works managers and superintendents have keystone positions and will be of invaluable assistance. Then, too, representatives of the manufacturers of water works equipment—particularly engineers—can do much to assist in the work at hand. These are not times to draw lines: It's a case of *every fellow with his shoulder to the wheel,* if the purposes of the Association and its friends are to be realized.

Remembering the words of President Roosevelt that "We must, *by prompt and vigorous action,* override unnecessary obstructions which have in the past delayed the starting of public works programs"—the American Water Works Association and its ally, the New England Water Works Association, have, as never before, an opportunity to show their true worth.

A pity, it is, that there is no parallel centralized organization to wage the same sort of campaign for sewerage—a field in which there appears to be so much to be done for the good of community and neighbor community.

▼

Self-Supporting Sewage Treatment

CAN sewage treatment be made to become in a major degree self supporting? A nice question: one that is being answered by practical demonstrations at several points. Impressive, is the article—"By-products of Sewage Treatment"—by James R. Rumsey, Engineer and Superintendent of the Grand Rapids (Mich.) Sewage Treatment Works, which appears in this issue.

To have visited the plant at Grand Rapids and to have known the author is to better appreciate his contribution to the economics of sewage treatment. Not satisfied with the production and sales of fertilizer from digested sewage sludge on a profitable basis for nearby consumption, he points to the demonstrated fuel value of surplus dried sludge and scum and shows how to utilize land and sludge for producing paying nursery crops and garden truck at a profit. And now, also to make use of even "the squeal," he shows that sludge gas utilization for operating gas-engines driving electric generators will produce an income at Grand Rapids (with current at 1.25 per k.w.h.) of $34,946. On that basis, with liberal depreciation taken into account, a net profit of $16,715.89 per year can be realized. Operating a 25 h.p. engine already yields a net saving of $700 per year in the bill for electric current at the plant.

In WATER WORKS AND SEWERAGE for May, 1933, an article by W. B. Walraven discloses the savings to be effected at the Springfield, Ill., plant from the operation of a 177 h.p. engine—the gas available being sufficient to supply more current than is required to operate the activated sludge plant. Based on present indications a net saving of $4,460 on plant operation will result for the year after allowing liberal depreciation. The Springfield installation represents the largest of its kind in America and is destined to become the forerunner of important gas engine installations at many sewage treatment works.

A gas engine operated at the new Newark, N. Y., activated sludge plant (as reported elsewhere in this issue) supplies all compressed air required and thus reduces the cost of treatment 33 per cent—i. e., $7.50 per million gallons.

Self supporting features of sewage treatment are emphasized further in the recent contract made to supply a railroad with effluent from the plant under construction at Herrington, Kansas—the income from which will pay all operating costs of the plant. At the Grand Canyon the reclaimed water for numerous purposes pays most if not all of the cost of the treatment and Los Angeles has also demonstrated that sewage can be profitably treated for power and water recovery values.

All of the above goes to show the many possibilities of making sewage treatment self supporting to a greater or lesser degree—probably the use of sludge and gas for power generation, fertilizer production for local sale and re-use of the water, offers the greatest possibilities for universal application.

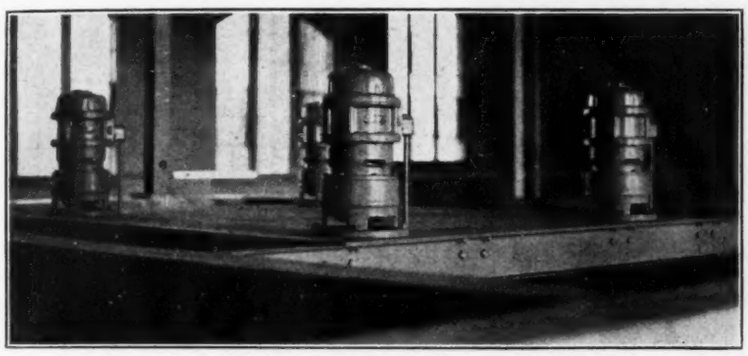
L. H. Enslow

NEW EQUIPMENT AND MATERIALS

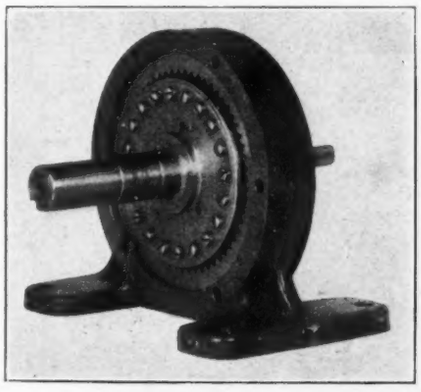
Attractive and Efficient Speed Reducer Adapted to Water Works and Sewerage

In planning water filtration plants and sewage treatment works the factor of appearances, as well as utility and efficiency, in the equipment used, has become an important consideration. The photograph below, showing the mixing devices at the new Fort Wayne filtration plant well ilustrates this "style trend."

In this and other recent installations one finds recent developments in integral unit agitators, with a vertically hung motor and speed reducer in an assembly, that is singularly compact and sturdy. The heart of this assembly is the heliocentric speed reducer which is presented by its manufacturers, Universal Gear Corp., Indianapolis, as the only radical advance or innovation in speed reducers in the past half century.



Mixing Devices, Fort Wayne, Ind., Filtration Plant—Equipped with Heliocentric Speed Reducers



Heliocentric Speed Reducers Showing Complete Working Parts

The largest agitator manufacturer in the country has adopted this speed reducer for its product and prominent water works engineers have used it in many recent installations.

The heliocentric reducer, while relatively new to many, already has a most diversified range of applications to its credit. It has, moreover, been in use at one filtration plant continuously for six years without repair expense or failure of any sort.

This radically different principle in speed reduction is here illustrated in a view showing its component parts.

Radical plungers are actuated by eccentrics on the input shaft and cause the element holding the output shaft to "walk around" the internal rack which is keyed securely to the case. A combined rolling and sliding contact is maintained between plungers and rack. Absence of wear and strain is most readily accounted for by the fact that approximately one-third of the plungers and teeth are sharing the load and that efficient lubrication insures long service. Contrast this with the single tooth-to-tooth engagement of ordinary gearing and it may be appreciated how such high ratios in such a small space are obtainable. The heliocentric element makes practical an efficiently operating reducer, in ratios up to 80 to 1, in a single stage. Furthermore, output revolution may be in the same or in opposite direction to the motor drive—all without resorting to intermediate gearing.

With heliocentric reducers efficiencies do not drop off as ratios are increased. The high efficiencies remain practically constant throughout the high ratio ranges commonly required in water purification, sewage treatment and similar work. This type reducer is ideal for driving mixers and agitators because vertical mounting is logical and its design is ideally suited for vertical work. This reducer is designed to carry considerable thrust load, not only the working load but the weight of the agitator as well. No difficulty whatever has been experienced with lubrication of the vertical heliocentric reducer because the moving parts are at the center and have little tendency to churn and heat the oil. It is no trick to keep temperatures low and maintain oil seals even with such large speed reductions as 1200 to 1.

If coagulation practice it is essential that agitators shall be operated at variable speeds which is accomplished by directly connecting the agitator shaft (through the speed reducer) to multispeed motors. For this work ratio preferences vary from 200 to 1 to 1200 to 1, depending upon conditions to be met. For vertical agitators in lime tanks, ratios of between 50 to 1 and 100 to 1 are commonly supplied through the reducer element.

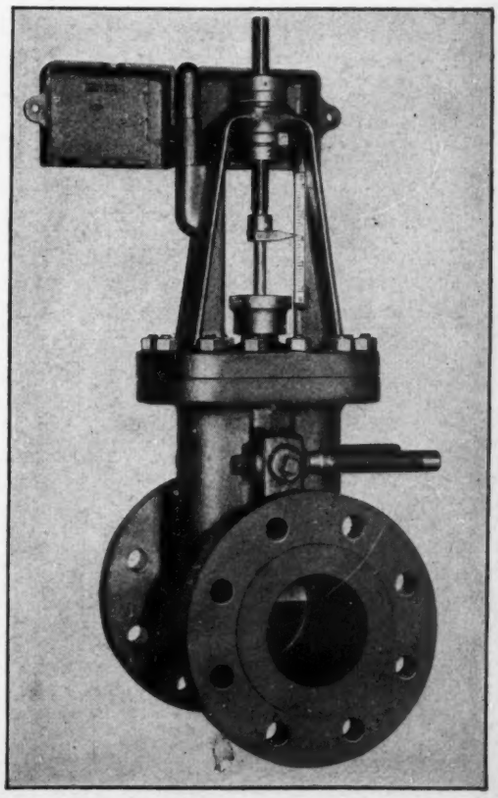
Heliocentric reducers are also ideal for use in the operation of variable speed sludge scrapers, mixing tanks or aeration devices used in sewage disposal. Because of its compact and neat appearance; because of the high efficiencies maintained at high ratios; because all ugly and cumbersome exposed gearing is eliminated, this equipment is rapidly gaining favor with engineers and water works operators as indicated by the large number of recent installations.

A more detailed description of the heliocentric reducer, and installations recently made should be of considerable interest to our readers, and may be obtained by addressing the Universal Gear Corporation, 19th and Martindale Aves., Indianapolis, Ind.

A Hundred Orifices in One

The new Bailey adjustable orifice pictured below is described in a recent leaflet titled "A Hundred Orifices in One" which is truly explanatory of this new piece of equipment.

The adjustable orifice is designed for use in connection with fluid meter installations



The Bailey Adjustable Orifice

where it may be desirable to change at intervals the maximum capacity of the meter. It may be used in connection with any differential head type of meter in connection with gas, steam, water, sewage and industrial operations such as at paper mills and the like. By its use the maximum capacity of the meter may be changed as much as 40 to 1, giving an accurate flow-measuring range of 160 to 1, by a simple setting of the micrometer screw (on the stem) at the proper point. An accurate setting requires but a few minutes without disruption of meter operation, and this piece of equipment is also highly useful for portable use and test service.

The illustration above shows the rugged construction, the orifice segment, the meter connections, the micrometer adjustment which is accurate to 0.001 of an inch, and the lock box which prevents tampering. A slight adjustment will compensate for deviations of pressure and temperature from meter design conditions, making it unnecessary to apply correction factors to meter readings. It is, therefore, literally "A Hundred Orifices in One."

For descriptive literature write The Bailey Meter Company, 1050 Ivanhoe Road, Cleveland, O.

A Corrosion Resistant Alloy Useful in the Treatment of Water and Sewage

The Haynes Stellite Company of Kokomo, Ind., has placed on the market a nickel-molybdenum-chromium-iron alloy called Hastelloy C. This alloy is resistant to hydrochloric, sulphuric, sulphurous, nitric, acetic and phosphoric acids and is particularly resistant to oxidizing agents such as free chlorine, hypochlorites, and acid solutions of sales which are oxidizing in nature such as ferric and cupric salts.

The resistance of Hastelloy C to chlorine and ferric chloride makes it particularly useful in the treatment of water and sewage where these chemicals are so widely used and it has already been adopted by a number of municipalities. In alternate immersion tests in concentrated ferric chloride made by the sanitary district of a middle western city Hastelloy C showed a loss of 58 milligrams per square decimeter per day while the next best material lost 13,000 milligrams per square decimeter per day.

Typical uses for such an alloy are for pumps, injectors, orifice plates, valves, pipe, fittings, bolts, clamps and special castings such as floats and other control equipment.

The Row Engineers, Inc., 50 Church St., New York City, are supplying equipment made of Hastelloy C to the water works and sewerage field for use in connection with ferric chloride and chlorine application.

John P. Harris Elected President of American Oil Chemists Society

John P. Harris, manager of the Chicago office of Industrial Chemical Sales Company, makers of Aqua-Nuchar and other grades of powdered activated carbon—was elected president of the American Oil Chemists Society at its recent meeting held in New Orleans. Prior to Mr. Harris' entry into the activated carbon field some six years ago he was a consulting chemical engineer and director of practical research for the American Institute of Meat Packers. He has worked hard in the interest of the American Oil Chemists Society for a number of years and well deserves the honor just bestowed upon him by that organization.

"Mighty Oaks from Little Acorns"

Below is a photograph of Wallace and Tiernan's exhibit at the recent convention of the American Water Works Association, held in Chicago, June 12-16.

In the face of rules of the A. W. W. A. Exhibit Contest Committee, stipulating that the same manufacturer could not win first award, two years in succession, this exhibit received the greatest number of votes by active members naming what in their opinion was the first, second and third most unique and instructive exhibits at the convention.

The Wallace and Tiernan Company has become famous for the quality of their exhibits as well as other things that go along with conventions, but the 1933 display was particularly impressive. It revealed what this organization has been doing in the way of producing new things during a depression period of lean earnings, when most corporations had clamped down the lid on development work and research—not to mention advertising—as soon as the flood of income from the "late golden-age" began to definitely dwindle.

Wallace and Tiernan chose to christen their exhibit "One-Fifth of a Century of Progress in Chlorination": This, in view of the fast that just 20 years ago the delicate looking little panel-type chlorinator on the wall in the center of the exhibit was the first one built by the two man pioneer organization, Fred Wallace and Mike Tiernan. Even the boy helper was probably lacking in 1913. The card on this chlorinator announces it to have been "The First Chlorinator Made by W. & T.—Installed on Jersey City's Water Supply in 1913."

This pioneer chlorinator has witnessed a lot of history making in chlorinator development during its 20 years of existence—which, after all, isn't a long time when we recall that the Chinese used alum for clearing muddy river water sometime B. C.

In the exhibit below this little "Jersey Skeeter" of a chlorinating device towers the "Empire State Building" amongst chlorinators, which the card proclaims to be "Today's Chlorinator—the W. & T. Universal Visible Vacuum Control Chlorinator." And to the left is the long distance chlorination control device—the latest of W. & T. developments—which has been dubbed the "Chlorinator-Monitor."

By use of telemetering principles this device is capable of transmitting chlorination control for any distance one can run an electric wire. This "Monitor" of chlorination, when operated in conjunction with the telemetering equipment, records rates of water flow, rates of chlorine application and the changes made by the operator at remote points from the point of the chlorinator installation. Change in rates of application is only a matter of creating the desired vacuum at the "Monitor" panel, and transmitting that vacuum to the chlorinator by wire. That's simple enough if one can figure out how to transmit vacuum over a solid wire.

Twenty years is a short time for the growth of such "mighty oaks from little acorns" but there is one thing we feel certain of: No ultra-violet rays have been administered to bring about this impressive metamorphosis of the "Jersey Skeeter" of 1913 to the "Empire State Building" of 1933.

Wallace and Tiernan truly deserved the vote their exhibit received at the A. W. W. A. convention.

"One-Fifth Century of Progress in Chlorination as Depicted by The W. & T. Exhibit at the A. W. W. A. Convention in Chicago

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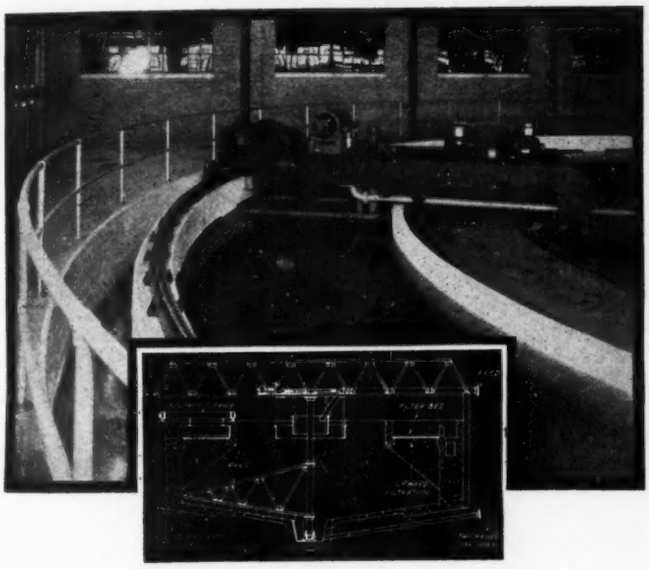

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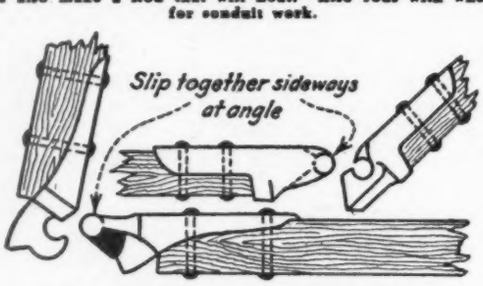

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GRADUATE CIVIL ENGINEER—Age 27; 6 years' experience in general municipal engineering (field and office); licensed professional land surveyor; accurate estimator; location immaterial. Am very anxious to secure more experience in the sanitary field. Can furnish the best of references. Address "J. W. G.," % Water Works and Sewerage, 400 W. Madison St., Chicago, Ill.

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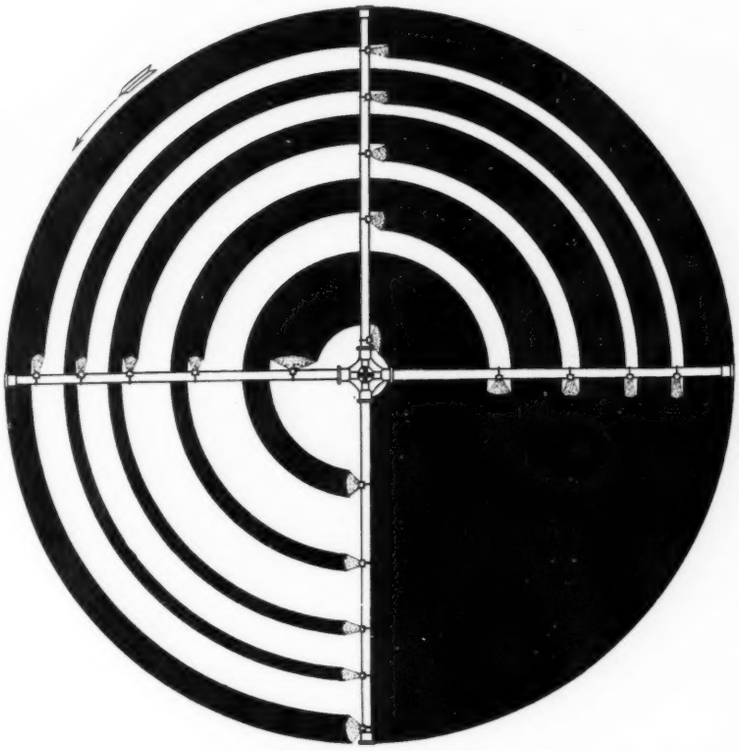
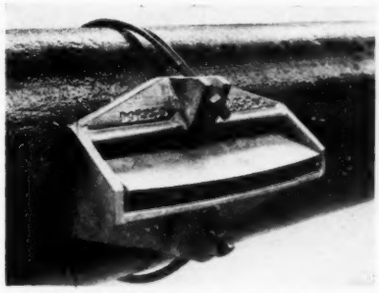
SANITARY ENGINEER—23, single, just graduated from the Massachusetts Institute of Technology with a B.S. in Sanitary Engineering; 3 years practical engineering experience; capable draftsman; formerly assistant engineer in charge of city sewer construction; desires connections with consulting engineer, municipality or State Board of Health. Address E. L. J., % Water Works & Sewerage, 420 Lexington Ave., New York City.

PROFESSOR, REGISTERED ENGINEER, wants university or college connection to install or build up department of sanitary and municipal engineering. Wide, successful field experience in addition to educational work. Capable of heading engineering division. Good executive, cooperator and organization builder. Will produce results. Address "E. W. M.," % Water Works and Sewerage, 400 W. Madison St., Chicago.

PUT YOUR FILTER ON THE SPOT
with a
DORRCO SEWAGE DISTRIBUTOR



Individually, every spray wets its own particular ring of bed area, as shown in southwest quadrant. Collectively, all of the sprays wet all of the bed area, as shown in southeast quadrant.



This special Dorrco spray nozzle discharges in a thin transparent sheet, adjustable both in volume and in shape.

The Dorrco Distributor applies a thin sheet of sewage over every square foot of the filter bed at every revolution. It never misfires due to plugged nozzles, freezing temperatures, power interruptions or leaking glands. Consequently 100 per cent coverage is assured 100 per cent of the time.

- **Operates solely by reaction of the sprays, under hydraulic heads ranging from 12 inches to several feet.**
- **Nozzles spaced and sized to apply same amount of sewage over each concentric ring of bed area.**
- **Flat—not round—sprays applied as thin transparent sheets—not as solid streams.**
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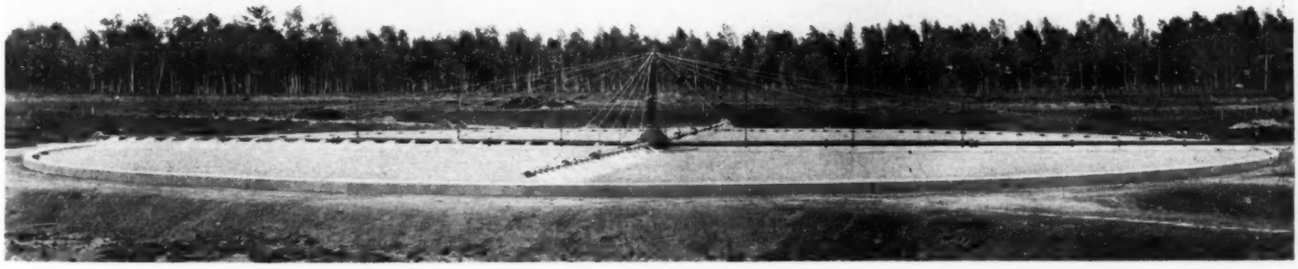
- **Complete drainage of all parts after each dose, thus preventing freezing in winter.**

If you know of a better way of feeding a trickling filter, we would like you to show us. If you don't, we would like to show you more about this one.



150 ft. diameter Dorrco Distributor at Escanaba, Mich.

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